AN EVALUATION OF ON-DEMAND TRANSIT USER AND INTERESTED-NON-USER CHARACTERISTICS AND THE FACTORS THAT ATTRACT THE TRANSIT-CURIOUS TO USING ON-DEMAND TRANSIT

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AN EVALUATION OF ON-DEMAND TRANSIT USER AND INTERESTED-NON-USER CHARACTERISTICS AND THE FACTORS THAT ATTRACT THE TRANSIT-CURIOUS TO USING ON-DEMAND TRANSIT

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[To my late uncle, Dr. Park Kihong 박기홍]
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LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

SUMMARY

CHAPTER 1.  Introduction

CHAPTER 2.  Literature Review
2.1  Past European and North American ODT experience
  2.1.1  North American ODT systems
  2.1.2  European ODT systems
  2.1.3  Mode substitution behavior among ODT users
2.2  Transit user satisfaction
2.3  Research gap

CHAPTER 3.  Methodology
3.1  User surveys
  3.1.1  Developing and distributing the surveys
  3.1.2  Processing the results
3.2  Modeling

CHAPTER 4.  Survey Results
4.1  Rider surveys
  4.1.1  Rider respondent characteristics
  4.1.2  Transportation usage and satisfaction
4.2  Non-rider survey
  4.2.1  Non-rider respondent characteristics
  4.2.2  Transportation usage and satisfaction

CHAPTER 5.  Modeling Results
5.1  Model selection
5.2  Logistic regression

CHAPTER 6.  Discussion
6.1  Characteristics of riders and non-riders
  6.1.1  Comparison of the two user groups
  6.1.2  Rider travel behavior
  6.1.3  Rider satisfaction
  6.1.4  Non-rider reasons for not riding
6.2  Rider or non-rider logistic regression
  6.2.1  Significant variables
  6.2.2  Insignificant variables
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>The six surveys and two survey sections, their relationships to the respondent groups, and their purposes.</td>
<td>22</td>
</tr>
<tr>
<td>Table 2</td>
<td>Participation number and rate for each of the three main survey instruments.</td>
<td>37</td>
</tr>
<tr>
<td>Table 3</td>
<td>The 11 input variables for model selection with their type and description.</td>
<td>69</td>
</tr>
<tr>
<td>Table 4</td>
<td>Fivefold cross validation scores for the seven algorithms.</td>
<td>71</td>
</tr>
<tr>
<td>Table 5</td>
<td>Logistic regression coefficients, standard errors, and significance for initial model specification.</td>
<td>75</td>
</tr>
<tr>
<td>Table 6</td>
<td>Logistic regression coefficients, standard errors, and significance for model with nominal income variables.</td>
<td>77</td>
</tr>
<tr>
<td>Table 7</td>
<td>Logistic regression coefficients, standard errors, and significance for model with income variable re-encoded as a Boolean indicating low income.</td>
<td>79</td>
</tr>
<tr>
<td>Table 8</td>
<td>Logistic regression coefficients, standard errors, and significance for model with insignificant variables dropped.</td>
<td>80</td>
</tr>
<tr>
<td>Table 9</td>
<td>Five-variable model with exponentiated Euler's constant using model coefficients.</td>
<td>87</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>MARTA Reach service areas overlaid on a map of Greater Atlanta.</td>
<td>3</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Age range of rider respondents.</td>
<td>38</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Education level of rider respondents.</td>
<td>39</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Gender of rider respondents.</td>
<td>40</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Annual household income of rider respondents.</td>
<td>41</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Race and/or ethnicity of rider respondents.</td>
<td>42</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Location of rider respondent home address within MARTA Reach zones.</td>
<td>43</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Location of rider respondent home address in MARTA Reach zones with zone buffer applied.</td>
<td>44</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Primary modes for work and school commuting before and after the introduction of Reach among rider respondents.</td>
<td>45</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Modes that respondents would have taken instead of Reach in its absence.</td>
<td>46</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Length and frequency of MARTA usage among Reach rider respondents.</td>
<td>47</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Overall satisfaction with MARTA services among rider respondents.</td>
<td>47</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Satisfaction with MARTA Reach among rider respondents.</td>
<td>48</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Degree of willingness to recommend ODT service to others among rider respondents.</td>
<td>49</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Hypothetical future frequency of planned ODT riding among rider respondents.</td>
<td>49</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Age range of non-rider respondents.</td>
<td>51</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Education level of non-rider respondents.</td>
<td>52</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Gender of non-rider respondents.</td>
<td>53</td>
</tr>
</tbody>
</table>
Figure 19  Annual household income of non-rider respondents. 54
Figure 20  Race and/or ethnicity of non-rider respondents. 55
Figure 21  Location of non-rider respondent home address within MARTA Reach zones. 56
Figure 22  Location of non-rider respondent home address within MARTA Reach zones with zone buffer applied. 57
Figure 23  Primary modes for work and school commuting among non-rider respondents after the conclusion of Reach service. 58
Figure 24  Length and frequency of MARTA usage among non-rider respondents. 59
Figure 25  Overall satisfaction with MARTA services among non-rider respondents. 60
Figure 26  Non-rider respondents' stated reasons for never taking a ride with Reach. 61
Figure 27  Split of riders and non-riders in the input data. 64
Figure 28  Correlation matrix before dropping and re-encoding variables. 65
Figure 29  Correlation matrix after re-encoding several variables. 67
Figure 30  Coefficients with absolute value above 0.4 singled out in correlation matrix. 68
Figure 31  Correlation matrix for variables to be used in model selection. 70
Figure 32  Confusion matrices for the seven algorithms. 72
Figure 33  Correlation matrix for model with nominal income variable. 76
# LIST OF SYMBOLS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODT</td>
<td>On-demand transit</td>
</tr>
<tr>
<td>MARTA</td>
<td>Metropolitan Atlanta Rapid Transit Authority</td>
</tr>
<tr>
<td>MoD</td>
<td>Mobility-on-Demand</td>
</tr>
<tr>
<td>DRT</td>
<td>Demand-responsive transportation</td>
</tr>
<tr>
<td>LA Metro</td>
<td>Los Angeles Metro</td>
</tr>
<tr>
<td>DART</td>
<td>Dallas Area Rapid Transit</td>
</tr>
<tr>
<td>QOS</td>
<td>Quality of service</td>
</tr>
<tr>
<td>SVC</td>
<td>Support vector machine classifier</td>
</tr>
<tr>
<td>MLP</td>
<td>Multilayer perceptron</td>
</tr>
<tr>
<td>AUC</td>
<td>Area under curve</td>
</tr>
<tr>
<td>Rider ID</td>
<td>Rider identification number</td>
</tr>
</tbody>
</table>
SUMMARY

Travel behavior has been rapidly changing and will continue to change as new mobility modes and technologies become available. Demand responsive transportation modes such as on-demand transit have allowed transit agencies to keep pace with changing travel dynamics. The Metropolitan Atlanta Rapid Transit Authority deployed its own on-demand transit system, dubbed MARTA Reach, in March of 2022. This thesis provides an evaluation of the characteristics of two groups of people related to MARTA Reach: those who were interested in it and used it and those who were interested in it but did not use it. In addition, this thesis explores the factors that influence membership in each of those two groups using a binary logit model, revealing the underlying characteristics that are linked with the decision to use or not use the service given prior interest. Understanding these group characteristics and underlying factors can help guide future efforts to provide on-demand transit service, such as by targeting the market segments that share features with the underlying factors that are shown herein to be linked with on-demand transit adoption.

The findings show that simply providing more service has the strongest effect on adoption. Among 561 survey respondents, 426 expressed that the service area for MARTA Reach was too limited for their needs. Modeling results support this finding, in addition to the following strong predictors of on-demand transit adoption: 1) being a frequent transit user, 2) being satisfied with the current state of fixed-route transit service, 3) being part of a low-income household, and 4) being younger.
CHAPTER 1. INTRODUCTION

Sub- and peri-urban environments, generally a challenging place for transit agencies to provide cost-efficient service, have proven to be a hot testbed for various emerging mobility solutions, particularly on-demand transit (ODT). With the changes in travel behavior accompanying work-from-home, transit agencies must adapt their operating models to continue to provide useful service to their users. Especially important is serving those who have poor access to transit, as this segment of the population is vulnerable to social isolation and deprivation due to lack of transportation access, and thus lack of access to the social-economic systems of cities that are vital to a community’s well-being. Such vulnerability can be exacerbated by the intersection of other factors, such as gender, age, race, and other socioeconomic variables. ODT has been shown to be an effective connection between areas experiencing deprivation and the respective remedial social services and opportunities [9] and presents a promising solution for transit agencies to continue to serve areas, or bring new service to areas, with poor transit access.

The Metropolitan Atlanta Rapid Transit Authority (MARTA) launched an ODT pilot named MARTA Reach on March 1, 2022. MARTA Reach met the definitional criteria of ODT, also referred to as mobility-on-demand (MoD) or demand responsive transit (DRT) in other literature, set forth by Wang et al [3]. The criteria are met as follows:

MARTA Reach…

- had a fare structure that charged trips on a per-passenger basis,
- was available to the general public,
• was responsive operationally to changes in demand,
• made use of vehicles smaller than a typical city bus.

These criteria distinguish ODT from other modes of publicly accessible mobility that operationally resemble ODT. For example, transportation network companies such as Uber and Lyft charge fares per vehicle. Paratransit, school buses, and employee shuttles are not available to the general public and thus are not ODT. Fixed-route transit services that are allowed to deviate from their route under certain conditions to meet demand are not ODT if the vehicle used is a typical city bus or equivalent in size.
Figure 1. MARTA Reach service areas overlaid on a map of Greater Atlanta.

MARTA Reach operated in three service areas, later expanded to four, depicted in Figure 1 superimposed on a map of the Greater Atlanta area. The service areas were disparate in terms of land uses, demographics, and geography. Service concluded August 31, 2022, 6 months after it began. Patrons could request a MARTA Reach vehicle using a
mobile application or a phone call. A thorough evaluation was conducted, including the analysis of performance data, usage data, demographics in the service area, and user data. This last category of user data includes user satisfaction and usage pattern data that was collected using a series of custom survey instruments developed by the research team and administered through the mobile application, excepting one of the surveys which was an on-board questionnaire administered person-to-person. This survey data and the development of a binary logit model to reveal factors influencing the decision of a person who is interested in ODT to ride ODT is the subject of this thesis.

This thesis continues in a thread of the existing literature concerned with the satisfaction of transit users. ODT user satisfaction has been shown to drive higher ODT usage [9], and its relationship with operational characteristics appears to be affected by intersectional factors of identity such as gender, age, and race. This thesis explores the research gap in the existing literature at this meeting point of satisfaction, intersectional factors, and modeling of these factors to reveal underlying influences on ODT adoption. What factors had an influence on a person’s decision to ride, or not ride, MARTA Reach, given that the person expressed prior interest in the service?
CHAPTER 2. LITERATURE REVIEW

This thesis draws on previous research and experience with ODT in Europe and North America, particularly around the idea of transit user satisfaction research. Of note are the papers by Xing, et. al., exploring the factors that influence ODT adoption among those who are interested in an ODT service that operated in Sacramento, California, and by Thao, et. al., conducting a similar study in the Canton of Bern, Switzerland. Xing, et. al., and Thao, et. al., develop a binary logit model-based method for discovering these factors [1][22], and this thesis shares many similarities with and expands upon the work of these two papers.

Broad differences exist between the ODT experiences in Europe and North America, and each experience within each continent is unique. These differences cannot be meaningfully resolved to arrive at a universal understanding of ODT and its effects, but each real-world experience provides useful insight into the interaction of ODT and its users. Consistent across all contexts explored in this literature review is the popularity of ODT with users, especially among those who are economically and/or socially marginalized. Unclear, however, is the effect of bias in where ODT service is selected to run in the first place, as ODT service areas are often specifically selected for their economic and social vulnerability [3]. What is clear is the benefit that ODT can provide to those with poor access to transit [9][11]. Understanding the underlying factors affecting ODT adoption will be key in further developing ODT as a useful and usual part of transit networks.
2.1 Past European and North American ODT experience

Many ODT systems have existed or currently exist throughout North America and Europe, and diverse analytical methods have been applied in their evaluations. ODT systems operate in a broad variety of service contexts, and in North America, ODT has been used to provide first- and last-mile connections [16][17][22][23] and to supplement fixed-route service, particularly during non-operating hours [9]. In Europe, ODT has been used in largely the same service contexts [3][5][26], but with additional emphasis on providing service to outlying rural and peri-urban areas [1][2][4].

2.1.1 North American ODT systems

ODT pilots have been deployed in numerous localities across North America. A Transit Cooperative Research Program synthesis report on the state of the ODT practice in 2019 interviewed 17 agencies that had provided or were currently providing ODT service and 5 agencies that were planning to provide ODT service, indicating that at least 22 of these pilots have been tried in the United States [21]. Despite the large number of ODT pilots that have existed in North America, literature comprehensively evaluating these pilots is comparatively limited in number. This section summarizes the findings from evaluations of 6 ODT pilots in North America. Three of the systems are part of the Mobility-on-Demand Sandbox program administered by the United States Department of Transportation. These MoD Sandbox systems were deployed in Los Angeles, California; the Puget Sound region in and around Seattle, Washington; and Dallas, Texas. Each of these systems has extensive accompanying literature and multiple evaluations. The remaining four systems summarized here are funded through other means. 5 of the 6
systems were in the United States and one was in Canada. None of these systems operated in a rural setting, in contrast to the European ODT systems explored later in this literature review. The following are the three pilots outside of the MoD Sandbox program identified as having accompanying literature:

- Sacramento, California – SmaRT Ride
- Gainesville, Florida – East Gainesville Microtransit
- Belleville, Ontario – On-demand bus

2.1.1.1 Mobility-on-Demand Sandbox systems

Within the United States, three ODT systems have been funded as part of the MoD Sandbox program. Among those, Los Angeles Metro’s (LA Metro) Metro Micro and Dallas Area Rapid Transit’s (DART) GoLink can be considered sister systems of MARTA Reach. Many aspects of MARTA Reach’s evaluation criteria built on the work of those two systems. In addition, Metro Micro and GoLink operate in the similar place-contexts of the peri- and sub-urban neighborhoods of a “Sun-belt” United States city much like those of Atlanta, with relatively high car dependence, low permeability of the built environment, and low density. An additional pilot system, Via to Transit in the Puget Sound region of the State of Washington, which encompasses the Seattle Metropolitan Area, was part of the same pilot program as Metro Micro. The purpose and character of each system is similar to that of Reach, as primarily a fragmented first-mile / last-mile connection to fixed route transit rather than its own new, continuous network [16][17]. Other pilots that were part of the MoD Sandbox program did not have an ODT component to them [18].
Martin, et. al., in an evaluation report of LA Metro Metro Micro and Puget Sound Via to Transit, used two surveys to evaluate the service. One survey was distributed early in the pilot period, while the other was distributed late in the pilot period [20]. Users in the Puget Sound pilot were found to be overall satisfied with the service. Importantly, the authors found that both pilots increased the number of transit users in each of the pilot’s operating areas [20].

Martin, et. al., in their evaluation report of DART GoLink, used a “Before and After Survey” and a “During Trip Survey” [19] to evaluate the impact of the service on users and gain insight into the user characteristics. Their findings showed that users were satisfied with GoLink. 27% of respondents to their surveys indicated that they called rides over the phone rather than using GoLink’s mobile app. Only 36% of respondents indicated that they had used an automobile in the past year, possibly showing low access to automobiles among the respondents, while 74% and 53% had used DART bus or light rail, respectively. 42% of respondents identified as Black/African America, 35% indicated an age between 25 and 34 years old, which was the largest category, and 57% identified as female with 0% identifying as “other” on the gender question [19].

2.1.1.2 Sacramento SmaRT Ride

Xing, et. al., explore willingness to adopt ODT and the barriers to doing so on the Sacramento Regional Transit District SmaRT Ride system in Sacramento, California [22]. The authors build several discrete choice models to explore these barriers. One of the models is a binary logit model estimating the likelihood of a respondent to be a SmaRT
Ride rider given certain data about the respondent such as their socio-demographic information and attitudes about transit.

The data used in the binary logit model were obtained via online survey. The authors used a popup message in the SmaRT Ride mobile app, social media platforms Facebook, Twitter, and Nextdoor, the Sacramento Regional Transit District website, a rider newsletter, and direct emails to recruit survey respondents. The authors note that these recruitment methods may have caused omission of those who do not have access to or cannot use these digital media. Respondents were incentivized using a raffle and a direct incentive later in the survey period. Out of 997 responses the authors received, 79.5% were SmaRT Ride riders and 19.5% had never ridden SmaRT Ride.

The authors showed age, education, having kids, having a “limit [on] one’s ability to drive” [22], liking SmaRT Ride, liking transit, sensitivity to travel costs, and sensitivity to travel time were all significant in their binary logit model. The interpretation of each variable’s coefficient and its sign are as follows. The model constant indicated that respondents were likely to use SmaRT Ride, keeping all other variables constant. Age, education, and liking transit each had negative sign, indicating higher age, higher education, and more positive feelings about fixed-route transit were linked with lower likelihood of being a rider. Having a child, having a “limit [on] one’s ability to drive” [22], having more positive feelings towards SmaRT Ride, being more sensitive to travel costs, and being more sensitive to travel time were each linked with a higher likelihood of being a rider.
2.1.1.3 **East Gainesville Microtransit**

In their evaluation of East Gainesville Microtransit, Steiner, et. al., developed a neighborhood-based survey available on paper and electronically [23]. The survey was distributed in-person at stops, on routes, at neighborhood businesses, schools, government buildings, and churches. The evaluation report does not indicate the use of any electronic recruitment methods, such as emails or social media. This distribution method allowed the authors to capture both ODT users and non-users. The survey was structured such that respondents indicated whether they had used ODT and branched into different questions depending on whether they had. This study design differs from that of Xing, et. al., since the recruiting methods used in that evaluation only captured respondents who were interested enough in ODT to sign up to receive emails regarding SmaRT Ride [22], whereas Steiner, et. al., deliberately attempted to recruit respondents who were not interested in ODT and specifically targeted respondents who did not have access to or ability to use digital media [23].

The survey effort gathered 18 responses from users and 35 responses from non-users. The users were found to typically ride transit daily and rarely walk or bike for transportation, be black, younger, have somewhat lower access to a car, and be overwhelmingly female. Non-users were found to rarely carpool or use rideshare such as Uber or Lyft, possibly indicating a general non-acceptance of on-demand shared transportation options [23].
2.1.1.4 Belleville on-demand bus

In their evaluation of an on-demand bus system in Belleville, Ontario, Zhang, et. al., developed an electronic survey designed for ODT users and distributed it via email [9]. The respondents received a gift card as incentive. The study design differs from those of Xing, et. al. [22], and Steiner, et. al. [23], as the authors here were not interested in respondents who had not taken ODT, and the survey was only distributed to confirmed riders [9]. In addition, the system operating context differs from that of the other systems in this literature review: the Belleville on-demand bus was deployed to fully replace fixed-route service during evening and night operations. The survey received responses from 263 unique respondents, representing 19.6% of the 1342 confirmed riders. The profile of the respondents was as follows: over 90% of respondents earned less than 40,000 Canadian dollars per year, 34% had full-time jobs, 24% were students, 6% owned a car, and less than 50% had access to a car or carpool. The authors also measured 15 aspects of user satisfaction. On average, respondents were neutral to satisfied about each of the 15 aspects of the ODT service. The authors note that 33% of trips had a wait time longer than 30 minutes, but in-vehicle time was reported as being shorter than that for the equivalent fixed-route service. The authors posited that wait times and in-vehicle times have an influence on user satisfaction, and these two opposing factors may have balanced each other out to a degree [9].

The primary purpose of this study was to explore changes in “nighttime activity participation” [9] because of the ODT service being introduced. The authors used exploratory factor analysis and structural equation models to gain insight into the factors governing these behavior changes among riders. The factor analysis revealed four latent
variables: the user’s satisfaction with 1) the user interface, 2) accessibility, 3) reliability, and 4) service quality. From the structural equation models, the authors find that gender identity is another significant factor, with women participating in more nighttime activities due to the availability of ODT than men. Respondent income and employment were found to be insignificant. Notably, car access and ownership were also found to be insignificant [9].

2.1.2 European ODT systems

Experience with ODT in Europe and the United Kingdom shows that the characteristics of the ODT user base are highly context-dependent. As a broad generalization, European ODT users are typically elderly, have low access to a car, and are living in low population density areas of the service area [1][2][3][4][5]. However, much heterogeneity exists even among these three factors in ODT users across systems. For example, the Kutsuplus system in Helsinki, the Wiltshire Wigglybus, and the Northumberland Phone&Go did not have elders as a primary user [26][4].

This section summarizes the findings of 6 European ODT papers. The 6 papers studied 10 systems, 8 of which are in the United Kingdom and 2 of which are in continental Europe. 5 of these systems are profiled within a single paper by Brake, et. al., and are marked with an asterisk (*). The system locations and names are as follows:

- Canton of Bern, Switzerland – Ebuxi
- Lincolnshire, United Kingdom – CallConnect
- Greater Manchester, United Kingdom – Local Link, Shopping Link
- *West Sussex, United Kingdom – DoRiS
- *Surrey, United Kingdom – DoRiS
- *Gloucester, United Kingdom – Village-Link
- *Wiltshire, United Kingdom – Wigglybus
- *Northumberland, United Kingdom – Phone&Go
- Tyne and Wear, United Kingdom – LinkUp
- Helsinki capital region, Finland – Kutsuplus

2.1.2.1 Bern Ebuxi

Thao, et. al., evaluated an ODT service called Ebuxi in the Swiss Canton of Bern operating in a peri-urban setting, with parts of the service area extending into nearby rural settlements. The authors developed a survey which was distributed via email, on-board, and through physical letters sent directly to residences, thereby capturing a wide range of user groups [1]. The authors divided their sample into users and non-users, as defined by whether the respondent used Ebuxi. The authors do not make a distinction between those who were interested in the service and those who were not, and recruited respondents who may or may not be interested or aware of the service via the letters sent to households. This aspect of the study design distinguishes this evaluation, subtly but significantly, from that of Xing, et. al., in their evaluation of SmaRT Ride [1][22].

The survey gathered 470 valid responses, of which 271 were users and 199 were non-users. The top reasons expressed by non-users for not using the service were a preference for walking, cycling, or using their private automobile instead. The top reasons expressed by users for using the service were the price, faster speed compared to walking, comfort, and lack of access to a car or public transit. The binary logit model built on the
survey data showed the following factors as influencing ODT adoption: age, education, access to a car, and holding a public transit “season pass”, equivalent to a monthly or annual pass more commonly seen in the United States. The authors interpret the coefficients and signs as follows: younger people were less likely to use ODT than older people, especially those 65 years old and up. Higher education was linked to higher likelihood of adopting ODT, notably opposite the expectation and results from other evaluations in the United States, such as the SmaRT Ride evaluation [22]. Having a public transit season pass and having access to a car were linked to a lower likelihood of using ODT. The authors find that gender identity, being employed, and having access to a bicycle had no significant influence on ODT adoption [1].

2.1.2.2 Lincolnshire CallConnect

Wang, et. al., used customer survey data directly from the Lincolnshire County Council, the English administrative equivalent of a county or regional government in the United States, to study “propensity to travel” on ODT among ODT users in 16 largely rural service areas [2]. The authors find that 62.69% of the 432 survey respondents are “very satisfied” with their ODT service, but also find that 45% of respondents travel “never/infrequently” on the service. Note the lack of differentiation between “never” and “infrequently”; the survey this study is based on did not seek to differentiate its sample into user and non-user groups. Presumably, all respondents had taken the service at least once. The survey respondents were overwhelmingly in the “70 or over” age category, which represented more than half of respondents, and the authors posited that this unbalanced age representation may be due to the service being free for those over 60 years old. The respondents were also overwhelmingly female, at 77%. The authors use an ordered logit
model to explore factors that influence the frequency with which a user rides ODT. They found that having a disability, living in a low population density area, traveling to work (rather than to another destinations), and being a male over 65 has a significantly positive influence on ODT trip frequency. They found that age has no influence on female propensity to ride [2].

2.1.2.3 Greater Manchester Local Link and Shopping Link

Wang, et. al., combine United Kingdom Census data and data provided by the ODT operators about each trip to develop a multi-level model that models ODT demand as a function of various factors, including socioeconomic variables and trip / service variables [3]. The Census data is available in agglomerations, called Lower Level Super Output Area, of small geographical units called Output Areas. According to the National Health Service, these agglomerations are roughly equal in population, with no fewer than 1000 people in an Lower Level Super Output Area [25]. These agglomerated Census units form the basis for the modeling done by Wang, et. al., in this evaluation, distinguishing it from previously discussed evaluations that relied on user surveys and/or interviews.

The authors interpreted their model results as follows. Higher ODT demand from a Lower Level Super Output Area is linked “with a lower population density; a lower proportion of people working from home; a higher proportion of white people; and higher levels of deprivation” [3]. Deprivation in this sense refers to lower socioeconomic well-being. A higher rate of private automobile ownership was found to be linked with lower ODT demand. The authors also note that 77% of ODT customers in Greater Manchester were female, but these data were not incorporated into their model because potentially
sensitive data that individually identified ODT customers were not made available to them [3]. Notably insignificant in this model was the proportion of the population aged 65 and up, in contrast to the findings from the Ebuxi and CallConnect evaluations [1][2].

2.1.2.4 Sussex, Surrey, Gloucester, Wiltshire, and Northumberland systems

Brake, et. al., demonstrate the presence of a growing market for rural ODT services in England, examining 6 ODT systems throughout the country. One of these systems, Lincolnshire CallConnect, was more thoroughly evaluated by Wang, et. al. [2], and will not be discussed in this section. The authors provided a customer profile, or a broad characterization of the typical user, for each of the systems. Unclear, however, is how these customer profiles were gathered. The following are the profiles. West Sussex DoRiS users are typically “older and/or female”, Surrey DoRiS users are typically “disabled”, Gloucester Village-Link users consist of “mostly disabled and elderly”, Wiltshire Wiggly Bus users are “mixed, many young”, and Northumberland Phone&Go users are “mostly school children” [4]. The authors demonstrate that the customer profiles of ODT systems are quite heterogenous, even within the same operating context within the same country.

2.1.2.5 Tyne and Wear LinkUp

Nelson & Phonphitakchai evaluated the user characteristics of Tyne & Wear’s LinkUp ODT system by sending randomly selected riders a survey by mail and analyzing the survey data [5]. Note that although recruiting was done via mail, the mail was only sent to the listed addresses of known LinkUp users. The survey had 326 valid responses. The authors also used some data from and compare their data to a survey conducted by Tyne & Wear’s regional transport authority about a week before the authors distributed their
survey. The respondents were found to be overwhelmingly female (79%) and over 60 years old (68%). The regional transport authority’s survey found roughly the same proportions at 76% and 70%, respectively, and that roughly 74% of respondents had little or no access to a car. The authors’ survey found that 79% of respondents left school before age 16 and that 69% are from households that make below 20,000 Great British Pounds per year. Most respondents were retired according to both surveys. The authors state that most riders have positive feelings towards the service, derived from freeform feedback on their survey. Respondents who stopped riding LinkUp, representing 34% of respondents, were typically frustrated with “booking or phone problems (28.6%) and journey problems (27.8%)” [5]. Negative sentiments gathered from the freeform feedback showed much the same issues with bookings and journeys.

2.1.2.6 Helsinki Kutsuplus

Weckström, et. al., used an electronic survey to understand the sociodemographic and attitudinal aspects of three groups in Helsinki, Finland: 1) those who had used the Kutsuplus ODT service and were still using it, 2) those who had used it and stopped, and 3) those who had never used it [26]. The survey was distributed on Facebook, Twitter, and via email to the Kutsuplus registered users. The authors collected 1440 responses, of which 939 were continuing users, 90 had used the service and stopped, and 390 had never used the service. The survey responses showed that most continuing users were olders and middle-income. Notably, Kutsuplus was well-used by respondents who also regularly used a car, and those who never used a car were also mostly respondents who had either discontinued their Kutsuplus usage or had never used it. Most respondents who had used the service, regardless of continuation or discontinuation of their use, rated the service
highly. The survey asked respondents to indicate why they used Kutsuplus, stopped using Kutsuplus, or had never used Kutsuplus, depending on which group the respondent indicated they were part of. The top responses indicating why the respondent used Kutsuplus were “lack of good public transport connection”, “low cost of Kutsuplus compared to taxi”, and “fast travel choice compared to public transport” [26]. The top responses indicating why the respondent stopped using Kutsuplus were a preference for other public transit modes and “vehicle unavailability & long response times” [26]. The top reasons for never using the service were lack of knowledge about the service and lack of coverage in terms of where the respondent wanted to go [26].

2.1.3 Mode substitution behavior among ODT users

Consistent across North American and European contexts is the possibility of ODT trips substituting trips that would be taken on other modes, including fixed route transit, walking, biking, and automobile [1][6][7]. Framed from the viewpoint of the user, this substitution behavior means that ODT can be a preferable alternative to other modes. Put another way, ODT is not consistently substituting trips for a specific mode or set of modes but is highly context- and individual-dependent. This contextual distinction is significant, because ODT service delivery paradigms exist in which ODT is the primary means of connecting a community to services [8], and the community is built around the ODT service in a similar fashion to streetcar suburbs in North America.

2.2 Transit user satisfaction

ODT user satisfaction is an important factor in how the ODT user uses the service. ODT users have specifically been shown to use ODT service for participating in social
activities more frequently if they are satisfied with the service, and they would otherwise not participate in the social activity [9]. The same can be said for transit overall, and it can be said in reverse: the way a transit user uses the service affects their satisfaction [12]. In addition, the user’s demographic characteristics may influence their satisfaction with the service [12].

A market segmentation effect exists in public transport user satisfaction wherein different user groups have different satisfaction levels with public transport service [15]. These user groups are often formed along sociodemographic lines, but Mao, Wang, and Wang develop a method to examine the influence of “environment and attitudes” in “Attitude and accessibility on transit users’ travel satisfaction: A person-environment fit perspective” [13]. The typical sociodemographic lines also undermine the heterogeneity of groups shown by the vast differences between within-group individuals and can lead to an ineffective group-politics that undermines the goals of empowering marginalized people [24].

Public transportation usage can be viewed largely as a social phenomenon [10]; its need arises not simply as a connection between two locations, but as a component of the social-cultural systems present in cities [14]. As such, the experience of transit, and thus satisfaction with it, is entangled with the social position of the user, and understanding the user’s social position is important to understanding underlying factors influencing ODT adoption.
2.3 Research gap

In the same research thread as the evaluations of SmaRT Ride [22], East Gainseville Microtransit [23], Ebuxi [1], CallConnect [2], and Kutsuplus [26], this thesis used user surveys distributed to those who signed up to use the service, separating them into two user groups depending on whether they did use the service, with demographic questions and satisfaction questions. The answers to the questions were processed and used as inputs in a binary logit model, also referred to as a logistic regression in this thesis, to understand the factors underlying this decision of whether to use the service after signing up. This thesis fills a gap in this research thread by examining interested users as a specific user group distinct from the disinterested non-user, in contrast to the East Gainesville Microtransit, Ebuxi, and CallConnect studies [23][1][2], while keeping those who did not ride the service as the majority class, in contrast to the SmaRT Ride and Kutsuplus studies [22][26]. This thesis also used a user survey designed to reach respondents who did not or could not use digital media, in contrast to the SmaRT Ride and Kutsuplus studies [26]. In addition, ODT adoption factors have not been studied in a context like that of Atlanta, and the findings of this thesis add a new type of place-context to this research thread.
CHAPTER 3. METHODOLOGY

The purpose of this study was to investigate three aspects of two MARTA Reach user groups. The first aspect was the user characteristics of MARTA Reach riders, the user group henceforth referred to as “riders”. The second aspect was the characteristics of users who registered an account with MARTA Reach but never took a ride with the service, the user group henceforth referred to as “non-riders”. The third aspect was the characteristics that were significant in differentiating riders from non-riders. Data was gathered through user surveys. The gathered data were processed and analyzed using tools available in the Python programming language and its packages. The processed data were used to build a classification model that predicted whether a user would be a rider or non-rider.

Data gathering consisted of distribution of 6 user surveys, which are discussed further in 3.1 User surveys. Analysis and processing are discussed in 3.1.2 Processing the results. Building the classification model is discussed in 3.2 Modeling. Table 1 illustrates the relationships between the six surveys and two sections of the Evaluation survey, which respondent group each survey was intended to be distributed to, and the purpose of each survey regarding its role as a primary data collection instrument or data gaps backfill instrument. The temporal relationship between the surveys is not illustrated in Table 1, but can be understood as follows. The Registration survey is akin to a “pre-treatment” survey, intended to gather information about the riders prior to using Reach, the “treatment”. The Trip survey is akin to a “during treatment” survey, intended to be taken while using Reach. The Evaluation survey is akin to a “post-treatment” survey, intended to be taken after having used Reach at least once. The Non-rider survey is a “control group” survey,
intended to be taken by those who did not ride Reach, as in “receive treatment”. The Evaluation survey includes sections to backfill data gaps in the Registration and Trip surveys. The Registration survey had its own dedicated data gaps backfill survey targeting respondents who had taken the Evaluation survey but not the Registration survey. The On-board survey was intended to capture riders who did not have access to or did not use digital media and backfilled data from those riders to all three Main surveys. The surveys are discussed in further detail in the following sections.

**Table 1. The six surveys and two survey sections, their relationships to the respondent groups, and their purposes.**

<table>
<thead>
<tr>
<th>Respondent group → Survey type ↓</th>
<th>Riders</th>
<th>Non-riders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main surveys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registration survey</td>
<td></td>
<td>Non-rider survey</td>
</tr>
<tr>
<td>Trip survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data gaps backfill surveys and sections of surveys</strong></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Registration section of Evaluation survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trip section of Evaluation survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registration backfill survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-board survey</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1 **User surveys**

A total of 6 user surveys were developed for the two user groups of riders and non-riders in the online survey platform Qualtrics and are each fully reproduced in APPENDIX.
A. Riders are users who completed one or more rides on Reach, where completed simply means that the rider was picked up and dropped off. Non-riders are users who registered for Reach but never completed a ride, including potential users who called a ride but canceled it. Non-riders are distinct from the general population in that definitionally the non-riders are potential users who showed some interest in the service while the general population includes both potential users and non-users. 5 of the surveys were intended for Reach users (riders), and one of the surveys was intended for people who registered for Reach but never took a ride (non-riders). All the surveys used similar style, tone, and question order and shared identical questions where comparisons were intended to be made between groups or time periods.

The rider surveys consisted of three main surveys, Registration, Trip, and Evaluation, and two minor surveys designed to fill data gaps in the three main instruments. The Registration survey asked about respondent mode choices, demographic information, and home addresses. Other information was gathered through the Registration survey such as transit fare card numbers and how the respondent first learned about the service, but those data were not used in this study. The Trip survey asked respondents to list their origin / destination type and address and the mode the respondent would have used in the absence of MARTA Reach. The Evaluation survey gathered information about user satisfaction, mode choices, and contained sections to fill gaps in the Registration survey’s demographic data and the Trip survey’s origin / destination and mode choice data.

The three main surveys were administered at differing times in the user’s journey, in the user experience sense and not the transportation sense, with MARTA Reach. The Registration survey was intended to be the first survey the user interacted with, ideally
around the time that they first registered for the service and had not begun taking rides. The Trip survey was intended to be taken any time the user took a trip on MARTA Reach and was the second point of interaction with this study. The Evaluation survey was intended to be taken close to the conclusion of service when a user had already had a chance to integrate Reach into their travel behavior and developed opinions about the service. In contrast to the three main surveys, the data gaps surveys did not have an intentional temporal position in the user journey and were administered ad hoc.

One of the data gaps surveys was a set of questions from the Registration survey administered to riders who had taken the Evaluation survey but not the Registration survey. That survey will be referred to henceforth as the Registration backfill survey. The other data gap survey was an in-person interview-style on-board survey designed to fill gaps in the Registration and Trip surveys caused by the mobile application-based administration method which excluded users who did not use the mobile application to call rides. That survey will be referred to henceforth as the On-board survey. Both data gaps surveys were distributed after initial distributions of the three main surveys.

The non-rider survey included the same demographic, mode choice, and home address questions as the Registration survey but also sought insight into why the non-rider did not take a ride with Reach. The non-rider survey was distributed after the 5 rider surveys and after the conclusion of the Reach pilot period.

3.1.1 Developing and distributing the surveys

The surveys were based on past MARTA Quality of Service (QOS) surveys, with modifications made to fit the needs of this study and to incorporate input from MARTA
team members. The QOS survey questions were supplemented with questions adapted from a survey conducted by Dr. Kari Watkins to assess mode shift during an Interstate highway closure in Atlanta, Georgia, and original questions created for this study. Using survey questions that had been part of past MARTA surveys allows for future comparison of the results of this study to other studies conducted by MARTA.

3.1.1.1 Registration

The Registration survey was designed to gather information about the user in the “pre-treatment state”, i.e., prior to using Reach but after their first interaction with the service through the mobile application. The survey was distributed through an anonymous link on the user profile page in the MARTA Reach app. The users were uniquely identified using a query string, called the rider ID, passed from the app to Qualtrics.

The survey was 18 questions long in total, with 2 of the questions being part of a branch. 10 questions were about user socio-demographics, including primary language spoken, gender, race/ethnicity, annual household income, number of children in household, etc, and were kept as similar as possible to questions asked on the QOS surveys. 3 questions based on similar QOS survey questions asked about the user’s transportation usage characteristics, including mode choice frequency for trips to work or school, the same for trips to non-work destinations, and the length and frequency of the user’s MARTA usage. 2 questions asked for the user’s MARTA transit fare card (Breeze Card) information, one question each asked for the user’s home address, how they heard about Reach, and for unconstrained freeform feedback.
The survey was available for users to take from March 24\textsuperscript{th}, 2022. Responses were collected until the conclusion of service on August 31\textsuperscript{st}, 2022, for a total uptime of 161 days. 144 valid, unique responses were collected, including responses that were created or supplemented using the data gap surveys and Evaluation survey. See Filling data gaps for further discussion on those surveys. The distribution pool was 653 users, and the response rate was 22.05%.

3.1.1.2 Trip

The Trip survey was developed to gather the user’s origin-destination, trip purpose, and alternative mode choice information while taking a Reach trip. The survey was distributed through the MARTA Reach app as an anonymous link pop-up after the user was marked as “picked-up” by a Reach vehicle operator. The users were uniquely identified using the rider ID query string.

The survey consisted of 6 questions, of which 2 asked the user for the address or placename of the origin and destination, 2 were about trip purpose and asked the user for the type of place the origin and destination were, and 2 asked the user to choose all modes that are part of their current trip and that would have been part of their trip had Reach not been available. The modes question also allowed the user to report that they would not have taken the trip in the absence of Reach. No questions on this survey asked for a freeform answer, except if the user chose to specify an Other option on the modes questions.

The survey was available for users to take starting May 9\textsuperscript{th}, 2022, to the conclusion of service on August 31\textsuperscript{st}, 2022, for a total uptime of 115 days. 307 responses from 191
unique respondents were collected out of a distribution pool of 653 users, for a response rate of 29.25%. Those figures include responses appended to the response set using data gathered from the data gaps surveys. For further discussion on the data gaps surveys, see Filling data gaps.

3.1.1.3 Evaluation

The Evaluation survey was developed to gather information about the user in the “post-treatment” state, i.e., after having time to incorporate Reach into their mode choice set, take at least one ride with Reach, and develop an opinion about the service. In contrast to the Registration and Trip surveys, the Evaluation survey was distributed through a unique link sent via email. The users provided an email address at the time of registration, and user responses to other surveys could be matched to Evaluation survey responses using a lookup table that had email addresses matched to rider IDs.

The Evaluation survey consisted of 5 questions blocks, 2 of which were simply the Registration and Trip surveys with minor modifications to fit into another survey. The Registration and Trip surveys were included in the Evaluation survey for the purpose of gathering responses from users who missed prompts to take those surveys. This aspect of the Evaluation survey is discussed further in Filling data gaps. The 3 question blocks that were unique to the Evaluation survey were constructed as follows. Question block 1 contained 15 questions, of which 6 were about technology usage and access regarding interaction with the service, 5 were about user satisfaction, 2 were about mode choices during the Reach service pilot period, 1 was about payment methods used for Reach, and 1 asked the user whether they had previously taken the Registration survey. If the user
answered no to the last question, the Registration survey question block displayed for them. Question block 2 contained 1 question asking the user if they had previously taken a Trip survey. If the user answered no, then a Trip survey displayed with questions modified to refer to the user’s most recent Reach trip in the past tense. Question block 3 contained 1 question asking the user for unconstrained freeform feedback about how Reach could have been better. The Registration question block contained 14 questions and the Trip question block contained 5 questions, for a total of 36 questions, making the Evaluation survey the longest survey of the 6 used in this study. Respondent fatigue was a concern, but the intent was for most respondents to be able to skip the Registration or Trip question blocks, or both, having already taken one or both previously. In practice, respondents did not recall whether they had previously taken one or both surveys and simply took one or both again. The reverse was also true, wherein respondents who had previously taken a survey reported that they had taken it.

The survey was distributed to users via email on August 8th, 2022, with reminders on the 12th and the 17th of August. The survey was distributed again on September 2nd, 2022, since between August 8th and the conclusion of service, the rider pool had increased in size with new users trying the service. Response collection was closed on September 23rd, 2022. The survey uptime was shorter for the Evaluation survey than the Registration and Trip surveys because of the difference in distribution methods, with the response rate to the Evaluation survey slowing down sharply one day after each distribution or reminder email. The distributions and reminders were sent at varying times on differing days of the week with the intent of capturing a more diverse sample, since people have varying
schedules throughout the day. 184 people responded to the survey out of the total pool of 653, which is a response rate of 28.18%.

3.1.1.4 Filling data gaps

Two surveys were designed to fill data gaps in the three main surveys: the Registration backfill survey and the On-board survey. The Registration backfill survey was distributed via email to users who took the Evaluation survey but had not taken the original Registration survey. The survey contained 2 questions, both about mode choice and frequency prior to the introduction of Reach, one each about trips to work / school and trips to non-work destinations. These questions were erroneously omitted from the Registration question block in the Evaluation survey.

The On-board survey was a printable version of the Evaluation survey designed to be administered by a surveyor to a passenger on board a Reach vehicle and was intended to take no longer than the length of the trip. In practice, surveys were left unfinished due to the passenger needing to alight at their destination. The survey had 34 questions and was structured similarly to the Evaluation survey with minor question ordering modifications and no possibility of skipping the Registration or Trip question blocks. The surveys were administered the week prior to the end of service, from August 25th, 2022, to August 29th, 2022. 26 valid responses were gathered from this method, which was intended to capture the user segment that did not use the Reach app to call rides. 7 of the respondents to this survey were found to be riders who did not use the app.
3.1.1.5 Non-rider

The non-rider survey was designed to gather information from users who signed up for the service but did not take a ride. The survey was distributed via email, which were on file from the time the users had registered. The intent of the timing of distribution was such that the service had concluded, and the rider and non-rider groups were two distinct, crystallized groups.

The survey consisted of 20 questions, of which 2 were questions about why the user did not take a ride with Reach asking for constrained and freeform answers, 1 was a question about overall satisfaction with MARTA service identical to its counterpart in the Evaluation survey, and the remaining 17 were identical to the mode choice, socio-demographic information, home address information, and freeform feedback questions from the Registration survey. The questions were kept identical where applicable to allow for direct comparison with responses from the riders. This survey included a higher number of opportunities for freeform feedback from the users. In addition, several respondents also sent unsolicited feedback via email by replying to the survey distribution email. This response mode was unique to the non-rider survey and provided further insight into the non-rider attitudes and beliefs.

The survey was distributed to users via email on December 7th, 2022, and reminders were sent on the 12th and the 16th of December. 761 valid, complete responses were collected from a total distribution pool of 5064 potential users who had registered but not taken a trip, for a response rate of 15.7%. The response collection was concluded on February 5th, 2023, for a total uptime of 60 days.
3.1.2 Processing the results

The results were imported using Qualtrics API into Python for processing. Before the importation step, Qualtrics dropped responses that were not complete. Complete is defined as the respondent reaching the final page of the survey. Entries from the various surveys were joined using a combination of the rider IDs and the user email addresses. A lookup table that matched rider IDs to email addresses also aided in joining responses to each other. All responses for the rider surveys were placed into a master table, with rider IDs and/or email address as primary keys and the survey response date as a secondary key. Note that the use of a rider ID or email address as the primary key depended on what the registered user database had on file for the user, as some users were registered users and thus had an email address on file but did not have a rider ID due to not using the mobile app and opting to call in to request rides. This way of organizing the data allowed multiple responses to be kept on file for a single user. Allowing multiple responses per user was particularly important for the Trip survey, which was intended to be responded to more than once by each user, although most respondents only responded once to it.

The only responses that were dropped from the rider survey response set were ones with more than about 80% of values missing or ones that could be clearly justified as being invalid responses. 19 responses were discarded under suspicion of falsification of responses by a surveyor in the on-board intercept survey. Otherwise, removal of responses or subsets of responses based on respondent behavior was done conservatively and only with clear justification, such as extreme values on questions that had a numeric answer. Subsets of 9 responses were discarded on this basis. No other suspicious response behavior was detected.
For the non-rider survey response set, two dropping criteria were used. Like the rider response set, if a non-rider response was missing more than about 80% of possible values, the response was dropped. In addition to this criterion, if the respondent indicated that they had, contrary to what the rider database showed, taken a ride on Reach, their response was discarded. 32 responses fell into this category. These responses were not appended to the rider response set as the rider surveys had been closed for several weeks and pilot service had concluded. The risk of adding 32 potentially erroneous or unreliable responses to the rider response set was far larger than the risk of lost information due to dropping them from the non-rider response set, as the rider response set is much smaller than the non-rider response set.

Respondents were asked to provide their home address. These responses were geocoded using Google Maps API, which performed nominally better than other solutions such as Nominatim with the widely varying address formats in which respondents inputted their addresses. The home locations were grouped based on the Reach service area that they were within. An approximately 2,000-foot buffer was also applied to the service area boundaries and home locations that fell within the buffer were included in the respective service area.

Two new variables developed from the survey responses were developed. One was a race / ethnicity variable that distilled the respondent’s response to the race / ethnicity question to a single race / ethnicity category. The categories were black, white, Latino, Asian, multi-racial, and other. Respondents indicating a single race / ethnicity were placed into the black, white, Latino, Asian, or other single-race categories depending on which of those choices they indicated. Respondents indicating more than one choice were placed
into the multi-racial category. The other new variable was a primary mode taken to work / school variable that distilled the respondent’s responses to the mode choice questions. The mode choice questions asked the respondent to indicate a frequency with which the respondent rides a mode. Frequencies above 4 times per week were taken as a primary mode, and then among primary modes, four broader categories and a hierarchy among the categories were established to arrive at a single primary mode category for the respondent. The four categories are the transit modes, automobile-based modes, active modes, and other modes. The hierarchy is as follows. Transit is highest, so a respondent indicating any transit mode as a primary mode was assumed to be using other non-transit modes to access transit, such as by taking rideshare to a MARTA station. Automobile-based modes are second in the hierarchy, so a respondent indicating rideshare, carpool, or private autos as a primary mode was assumed to be using modes below automobiles in the hierarchy to support automobile usage, such as by walking to a parking lot. Active modes are third in the hierarchy, so a respondent indicating bikeshare, scooter-share, biking, or walking as their primary mode would be assumed to have other, unspecified modes supporting their active mode usage. The last mode category in the hierarchy is the other category, which is simply the “other” option which also allows user elaboration of what that other mode is through free-form input on the survey.

One question had variables that were manually re-encoded using respondent free-form responses. A question on the non-rider survey asked respondents to indicate why they had not taken a ride with Reach. The question had an “other” response category that allowed freeform input. If appropriate, the “other” responses were manually re-encoded to an existing category or to one of four added categories which emerged during manual re-
encoding. See the commentary on Figure 26 in 4.2.2 Transportation usage and satisfaction. Altogether, 126 responses to this question were re-encoded.

3.2 Modeling

Using the collected survey data, a binary classification model was built with “rider” and “non-rider” as the predicted classes. Questions about demographics, overall MARTA service satisfaction, length of MARTA usage, home address, and frequency of usage of transportation modes were identical or asked with minor modification across the rider and non-rider surveys. Because of this equivalence, the responses could be used as classification model input variables across the two classes with little to no manipulation.

The datasets used for modeling were built on the demographic and geographic, MARTA satisfaction and length of usage, and modes responses for each respondent. Respondents either belonged to class “rider” or “non-rider”. The variables were variously encoded and re-encoded, and several different combinations of variable encoding strategies were explored, with model performance, conceptual consistency, and model interpretability as the primary concerns when choosing the appropriate encoding schema. Variables were dropped based on high collinearity with other variables, or, during model refinement, based on insignificance.

Seven classification and classification-like algorithms were evaluated using cross-validation and metrics such as accuracy, precision, recall, F-score, and the highest performing model overall was chosen. The size of the rider and non-rider classes was imbalanced, with considerably more non-riders than riders. This imbalance can lead to poor model performance and difficulty in selecting meaningful features. The model evaluation
showed that logistic regression performed best and was chosen for building a more refined model. The data encoding, model selection, model refinement, and results are all presented in greater detail in CHAPTER 5 Modeling Results.
CHAPTER 4. SURVEY RESULTS

4.1 Rider surveys

Surveys were administered to riders with five survey instruments: the Registration survey, the Trip survey, the Evaluation survey, an on-board survey and a targeted survey designed to fill in gaps in data from certain user groups. The surveys were designed such that any user could participate in one or more of the Registration, Trip, and Evaluation surveys, while the on-board and targeted surveys were not designed for cross-participation. The on-board and targeted surveys were designed to fill in gaps in the Registration, Trip, and Evaluation surveys, and the responses from the on-board and targeted surveys were appended to their respective corresponding survey. The Registration survey and the Trip survey were administered through the MARTA Reach mobile application as a direct anonymous link to Qualtrics. Respondents were uniquely identified using their rider identification number (rider ID) passed to Qualtrics from the Reach app. The Evaluation survey and the targeted survey were administered using unique links generated for each email address, which the users provided when registering for the service through the Reach app. The on-board survey was administered by a team of surveyors on board Reach vehicles in an interview-like format.

Among registered users, 653 took a ride with Reach. Within that group, 268 provided a valid response to at least one of the five surveys, for a participation rate of 41%. A valid response is a response with at least five questions answered and the end of the survey reached by the respondent.
The participation rates for each survey instrument are shown in Table 2. For the purposes of the participation rate calculation, the on-board and targeted survey responses are joined with their respective corresponding survey, and if the respondent is unique for the corresponding survey, they are counted as an additional respondent. For example, if Person A and Person B had each responded to the on-board survey, and Person A had already responded to the Registration survey and Person B had not, Person A’s responses from the on-board survey that map to the Registration survey would not be counted as a new response for the participation calculation, while those of Person B would be counted as a new, unique response. All the surveys and combinations of surveys had response rates above 14%, with the Trip survey having the highest response rate at 29.25%.

**Table 2. Participation number and rate for each of the three main survey instruments.**

<table>
<thead>
<tr>
<th>Survey instrument(s)</th>
<th>Unique respondents</th>
<th>Participation rate (out of 653 registered riders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>144</td>
<td>22.05%</td>
</tr>
<tr>
<td>Trip</td>
<td>191</td>
<td>29.25%</td>
</tr>
<tr>
<td>Evaluation</td>
<td>184</td>
<td>28.18%</td>
</tr>
<tr>
<td>Registration and Trip</td>
<td>101</td>
<td>15.47%</td>
</tr>
<tr>
<td>Registration and Evaluation</td>
<td>124</td>
<td>18.99%</td>
</tr>
<tr>
<td>Trip and Evaluation</td>
<td>118</td>
<td>18.07%</td>
</tr>
<tr>
<td>Registration, Trip, and Evaluation</td>
<td>92</td>
<td>14.09%</td>
</tr>
</tbody>
</table>
4.1.1 Rider respondent characteristics

Broadly, the five surveys asked respondents to provide demographic, home location, satisfaction, origin-destination, and travel behavior information. The information gathered from the surveys is presented in the following sections in graphics.

4.1.1.1 Rider demographics

![Age (riders) Pie Chart](image)

**Figure 2. Age range of rider respondents.**

Riders younger than 18 years old were not invited to participate in the survey for reasons of ethics regarding human subjects research of minors. For this reason, the proportion of riders who were minors is unknown. Respondents are predominantly younger than 44 years old, with 70.4% of respondents falling into that category. 55 years old-and-up riders comprised 11.97% of respondents. The largest age group among respondents is
the 25 to 34 group, comprising 30.3% of respondents. The results are graphically represented in Figure 2.

![Education (riders) Chart]

**Figure 3. Education level of rider respondents.**

The majority of respondents have at least a bachelor’s degree, with 50.4% falling into that category. The vast majority of respondents have completed high school, at 97.68% of respondents. See Figure 3 for the full response set.
Men and women comprise an even split of the respondents, with each having 47.9% of the share of respondents. Four respondents either declared non-binary gender or self-described their gender, representing 2.86% of respondents. Figure 4 illustrates the responses to the gender questions.

Figure 4. Gender of rider respondents.
Most respondents are in the “Low” household income category, meaning that their household’s income is less than $49,000 per annum, at 56.7% of respondents. See Figure 5 for the proportion of respondents in each income category.
Figure 6. Race and/or ethnicity of rider respondents.

Respondents were allowed to choose multiple answers for the race / ethnicity questions. Any respondent who chose more than one of Black, White, Latino, Asian, and Other was categorized as Multi. Most respondents chose Black as their only answer, with 58.5% responding in this way. The second largest share of respondents chose White, at 23.8%. Figure 6 shows the proportion of respondents in each race / ethnicity category.
4.1.1.2 Rider location data

Figure 7. Location of rider respondent home address within MARTA Reach zones.

105 respondents provided the location of their home address, and the results were geocoded and mapped. 71 of those respondents provided home addresses within MARTA Reach zone boundaries, while 34 provided home addresses outside of zone boundaries. Figure 7 shows the proportion and number of respondents with home addresses in each of the zones and those outside of zones. Notice that Fort Gillem Phase 1 is not listed, as no respondents reported a home address within that zone.
Figure 8. Location of rider respondent home address in MARTA Reach zones with zone buffer applied.

A buffer of approximately 2,000 feet captured home addresses close to zones but not within zones. 15 respondents who were classified as out-of-zones were reclassified as within zones with the buffer, representing about 14% of respondents. After buffering, 19 respondents, or 18.1%, lived outside of zones, indicating the possibility of a significant proportion of riders living well outside of the zones and using other modes to reach the service areas or making trips that were not home-based. Figure 8 shows the reclassified home address counts in each zone.
4.1.2 Transportation usage and satisfaction

Respondents were asked to report how often they use each of several modes. The modes were aggregated into the four categories of Transit, Auto, Active, and Other, and the frequency of mode usage was ranked to arrive at a primary mode for each respondent. See Methodology section for further discussion on the primary modes. Before the introduction of Reach, respondents were primarily transit users, with 78.5% of respondents reporting using transit often to get to work or school. After the introduction of Reach, respondents were primarily Reach users, at 60% of respondents. Reach being the most common primary mode does not rule out the possibility of multimodality of Reach trips. The primary mode simply indicates what mode the respondents uses predominantly. See Figure 9 for the mode breakdown.

Figure 9. Primary modes for work and school commuting before and after the introduction of Reach among rider respondents.

Respondents were asked to report how often they use each of several modes. The modes were aggregated into the four categories of Transit, Auto, Active, and Other, and the frequency of mode usage was ranked to arrive at a primary mode for each respondent. See Methodology section for further discussion on the primary modes. Before the introduction of Reach, respondents were primarily transit users, with 78.5% of respondents reporting using transit often to get to work or school. After the introduction of Reach, respondents were primarily Reach users, at 60% of respondents. Reach being the most common primary mode does not rule out the possibility of multimodality of Reach trips. The primary mode simply indicates what mode the respondents uses predominantly. See Figure 9 for the mode breakdown.
Figure 10. Modes that respondents would have taken instead of Reach in its absence.

Figure 10 shows results from the Trip survey question asking respondents which modes they would have taken in the absence of Reach service. The modes were binned into the four categories of Transit, Auto, Active, and Other. Respondents were allowed to choose more than one mode as a substitute for a given Reach trip. 270 trips taken by the 307 respondents would have been taken on fixed-route transit, which is consistent with the respondent primary modes, illustrated in Figure 9. The Auto and Active modes are more strongly represented in this dataset than in the primary modes data, indicating a multimodality in the respondents’ travel habits that was lost in the primary modes data processing. 35 trips taken by the 307 respondents would not have been taken had Reach not been available, indicated in red in Figure 10.
Figure 11. Length and frequency of MARTA usage among Reach rider respondents.

How long have you been using MARTA? (riders)

- Began riding recently: 5.6%
- Long-time infrequent rider: 23.6%
- Long-time regular rider: 70.8%

N=106

Figure 12. Overall satisfaction with MARTA services among rider respondents.

Satisfaction with MARTA overall (riders)

- Very satisfied: 35.6%
- Satisfied: 39.7%
- Neither: 13.4%
- Dissatisfied: 5.1%
- Very dissatisfied: 5.6%

N=194
Figure 11 shows results from survey questions about the length and frequency of respondents’ MARTA usage patterns. A possible choice was “Never ridden MARTA before”, and none of the respondents chose that response. Most respondents are long-time regular riders, at 70.8% of respondents. The “regular”, “infrequent”, and “recently” aspects of the three answer choices displayed in Figure 11 were not prescriptive or defined and were up to the interpretation of the respondent. Most respondents (75.3%) are at least satisfied with MARTA services overall, while 11.34% are dissatisfied or very dissatisfied, as shown in Figure 12. For MARTA Reach service, 94.3% of respondents are at least satisfied and 3.12% of respondents are dissatisfied or very dissatisfied, as shown in Figure 13. More respondents are satisfied or very satisfied with Reach than with MARTA overall.

Figure 13. Satisfaction with MARTA Reach among rider respondents.
Figure 14. Degree of willingness to recommend ODT service to others among rider respondents.

Figure 15. Hypothetical future frequency of planned ODT riding among rider respondents.
Respondents were largely willing to recommend ODT to others and planning to ride ODT the same amount or more in the future, at 94.4% and 95.8% of respondents in each category, respectively. 2.7% of respondents would not recommend ODT, and 2.7% of respondents plan to ride less often in the future. See Figure 14 and Figure 15 for visualizations of each response set.

4.2 Non-rider survey

The non-rider survey was distributed to 5,062 email addresses on December 7th, 2022, 98 days after the conclusion of MARTA Reach service. 836 respondents took the survey, with 792 completing it, for a 16.5% response rate. The email addresses were provided by users when registering to use Reach, with each user providing one email address. As such, the email addresses were intended to be a unique identifier, although nothing prevented a user from registering twice under different email addresses.

The survey consisted of 20 questions, with 2 of the questions being entirely unique to the non-rider survey, and the remaining being the same as questions asked to obtain demographic and mode choice information on the Registration survey.

4.2.1 Non-rider respondent characteristics

The non-rider survey asked respondents to provide demographic, home location, satisfaction, and travel behavior information. The information gathered from the surveys is presented in the following sections in graphics. See 6.1.1 Comparison of the two user groups for a discussion on the differences between the riders and non-riders.
4.2.1.1 Non-rider demographics

Among non-riders, those under 44 years of age represent 54.9% of the respondents. Those over 44 comprise 42.2% of respondents. As with the rider surveys, minors were not invited to participate, so the proportion of non-riders under 18 is unknown. See Figure 16 for all age ranges and their numbers and proportions within the respondent group.

Figure 16. Age range of non-rider respondents.
Figure 17. Education level of non-rider respondents.

67.8% of non-rider respondents are college-educated, with an additional 20.2% having attended some college. 98.3% have graduated high school. See Figure 17 for each education category and its proportion and number of respondents.
Figure 18. Gender of non-rider respondents.

Slightly more men are non-rider respondents than women, at 48.0% and 45.3% of respondents reporting their gender as man or woman, respectively. 2.7% of respondents are non-binary or self-reported their gender. See Figure 18 for all gender data from the non-rider respondents.
Figure 19. Annual household income of non-rider respondents.

Figure 19 shows the number and proportion of non-rider respondents in each household income category. Middle income is the largest category, representing 34.7% of respondents, followed by low income, with 30% of respondents.
Figure 20. Race and/or ethnicity of non-rider respondents.

The non-rider respondents have a nearly even split between those identifying as white and those identifying as black, at 43.9% and 34.6% respectively. The remaining categories comprise 21.5% of the non-rider respondents, with a roughly even split between Asian, Latino, and Multi-ethnic, and with Other being 1.17% of respondents. See Figure 20 for the number and proportion of each response category. As with the race/ethnicity questions on the rider surveys, the non-rider survey also allowed multiple answers for the race/ethnicity question. Responses to the question were processed to derive the multi-ethnic categorization when a respondent indicated that they identified with multiple races/ethnicities. The count of respondents in each of the categories excepting Multi are the number of respondents indicating identification with solely that category and none of the others.
4.2.1.2 Non-rider location data

Figure 21. Location of non-rider respondent home address within MARTA Reach zones.

Figure 21 shows that non-rider respondents largely live outside of a MARTA Reach zone, at 82.8% of respondents. The most respondents to live in a service area is in the Belvedere service area comprised of the Belvedere Phase 1 and 2 zones, with 8.8% of respondents reporting a home address in the Belvedere service area. Westside, comprised of the Westside Phase 1 and 2 zones, was the second most lived-in service area at 5.1% of respondents reporting a home address there. As with the rider survey respondents, no non-
rider respondents reported a home address in Fort Gillem Phase 1, which is why it is absent from Figure 21.

![Non-riders living in zones](image)

**Figure 22. Location of non-rider respondent home address within MARTA Reach zones with zone buffer applied.**

Applying a zone buffer of approximately 2000 feet captured additional non-rider home addresses that were within 2000 feet of a zone boundary. Figure 22 shows the results of applying the buffer. About 12.3% of non-rider respondent home addresses are re-categorized as within zones after application of the buffer. Belvedere contains 16.2% of home addresses with the buffer, which is nearly double what it contains without the buffer.
Each of the other zones also sees similar gains, indicating that many home addresses of non-rider respondents were within 2000 feet of a zone boundary.

4.2.2 Transportation usage and satisfaction

Figure 23. Primary modes for work and school commuting among non-rider respondents after the conclusion of Reach service.

The largest share of non-rider respondents are primarily transit users, and the second largest share are primarily automobile users, with 45.7% and 44.3% of respondents in each category, respectively. This primary mode split close to evenly divides 90% of non-rider respondents into automobile and transit users. The remaining 10% of respondents are mostly those with active modes as their primary mode, at 8.8% of respondents. See Figure 23 for a visualization of the primary mode split among the non-rider respondents. As with
the primary mode figures for the rider respondents, primary modes for non-riders should be understood as simply the mode the respondent takes most often to reach their work or school. The primary mode does not indicate how multimodal a respondent’s work or school journey is, nor does it indicate how frequently the respondent uses other modes, nor does it indicate how varied the respondent’s mode choices are.

Figure 24. Length and frequency of MARTA usage among non-rider respondents.

Figure 24 shows that most non-rider respondents are MARTA users, with 3% responding that they have never ridden MARTA before, and the remaining 97% of respondents riding MARTA at least infrequently. The Long-time infrequent riders and Long-time regular riders form roughly equally sized groups among non-rider respondents. Those who Began riding recently are 9% of respondents.
Figure 25. Overall satisfaction with MARTA services among non-rider respondents.

47.6% of non-rider respondents are at least satisfied with MARTA service, while 23.6% are dissatisfied or very dissatisfied. 28.8% are neither satisfied nor dissatisfied. The extremes of very satisfied or very dissatisfied represented the views of 14.3% of respondents. See Figure 25 for the stated satisfaction level of non-rider respondents with overall MARTA services.
Non-rider respondents were asked to indicate why they never took a ride with MARTA Reach despite signing up for the service. Figure 26 shows the results from this question. Respondents could indicate multiple reasons and were asked to provide clarification if they chose Other. 561 respondents answered this question and a total of 804 response choices were collected. Out of those 804 response choices, 426 indicated that Reach did not serve their origins or destinations, 137 indicated that they did not understand how to use the service, 97 indicated that the operating hours are too limited, 60 indicated an issue with the app or the service, 24 indicated that other options are cheaper or that walking / driving were preferable, 24 indicated that the respondent had signed up but were too late in the pilot to ride or had no intention of riding, and 39 indicated an “Other reason” that was not listed. 32 respondents indicated that they had taken a ride with Reach and that
their classification as a non-rider was in error. Their responses were removed from the non-rider response set, as discussed in 3.1.2 Processing the results.

126 responses that initially indicated “Other reason” were re-encoded manually into the existing categories of “Other options are cheaper”, “Issues with the service”, “Issues with the app”, “Didn’t understand how to use [the service]”, “Operating hours too limited”, or “Didn’t go where I need [the service] to”. Four categories emerged during re-encoding and are “Found out about the service too late [to try it]”, “Wanted to check [the service] out but not ride”, “Could walk instead”, and “Had access to a car”. The 39 responses that remained in the “Other reason” category could not be re-encoded because the reason being expressed was unique, the reason could not be understood, or the reason did not pertain to Reach.

Major differences appear to exist between riders and non-riders in all variables explored in this section except in terms of gender identity. The following chapter, CHAPTER 5 Modeling Results, explores these differences further and develops a logistic regression to reveal the underlying factors in ODT adoption. See CHAPTER 6 Discussion for further discussion on the survey results, modeling results, and interpretation of each.
CHAPTER 5. MODELING RESULTS

To build the modeling datasets, the demographic and geographic, MARTA satisfaction and length of usage, and modes responses were extracted from each of the rider and non-rider groups. The target variable, “rider”, was created and responses from the rider surveys were labeled “rider”, while responses from the non-rider survey were labeled “non-rider”. All responses were concatenated into a single dataset with the target variable, “rider”, as a column. The variables were then encoded according to the data type. Two discrete numerical variables – number of people in the household and number of children in the household – were among the inputs, but the remaining variables were all ordinal or nominal categorical data. The nominal variables were encoded using the “dummy variable” method and the index variable removed from the variable set. Ordinal variables were given codes from 0 to the number of categories. Missing data was not re-encoded in any way and entries containing missing values were removed from the dataset.

All responses containing null values were dropped, and the split of riders versus non-riders analyzed was as shown in Figure 27, with 406 non-riders and 69 riders out of 475 total respondents. The imbalance between these two classes could be challenging for classification algorithms. Evaluation of seven classifiers, including a logistic regression which is not strictly a classifier but can be made to behave like one, is shown in 5.1 Model selection. Modeling these classes is much better suited to certain algorithms, likely partially due to this imbalance.
Riders and non-riders in sample

Figure 27. Split of riders and non-riders in the input data.

Input variables were examined in a correlation matrix after encoding but before dropping the index variable from the dummy variable-encoded nominal variables. Some variables showed high correlation with each other and were thrown out. Figure 28 shows the correlation matrix before any variable dropping or re-encoding. High correlation is depicted by darker red or blue, depending on whether the correlation is positive or negative, respectively.
Since man and woman are part of the same dummy variable set for gender, instead of dropping man or woman as an index variable, the gender variable was simply re-encoded as a Boolean variable indicating whether the respondent is a woman or not. The proportion of respondents indicating a non-binary or self-declared gender was very low for both riders and non-riders, as shown in Figure 4 and Figure 18, so losing some granularity with this re-encoding would not interfere with model validity or predictive power. Black and white are also part of the same dummy variable set for race / ethnicity, and the race / ethnicity variable was re-encoded as a Boolean variable indicating whether the respondent is white.
or not. Again, the proportion of respondents indicating a race / ethnicity outside of the black and white binary was low, as shown in Figure 6 and Figure 20, so the model should not be impacted by the information loss caused by this method of encoding. The service area variables, which are Belvedere Phases 1 and 2, Fort Gillem Phase 2, NFCID, Out of Zones, and Westside Phases 1 and 2, were re-encoded as a Boolean variable indicating whether the respondent lived out of zones or not. The specific service area that the respondent lived in was not important for this model and this re-encoding did not result in any loss of information. The same was true of the primary mode taken to work / school variable set, represented by active, auto, other, and transit. The mode most useful to the analysis was transit, so the variable was re-encoded to simply indicate whether the respondent primarily takes transit to work or school. Figure 29 shows the correlation matrix after re-encoding of the variables.
A correlation coefficient absolute value above 0.4 between exogenous variables is present in five variable pairs: number of people in household and number of minors in household with a coefficient of 0.59, income – education with 0.57, transit – income with -0.049, transit – length of MARTA ridership with 0.42, and white – income with 0.44, as shown in Figure 30. The variable people_in_household, indicating the number of people living in the respondent’s household, may need to be dropped to avoid problems arising from collinearity.
Figure 30. Coefficients with absolute value above 0.4 singled out in correlation matrix.

The dataset used for model selection consisted of 11 input variables and the one target variable. Table 3 shows the variables along with their variable type and a detailed description of how the variable is coded and what it represents. Figure 31 shows the correlation matrix including all the listed variables.
Table 3. The 11 input variables for model selection with their type and description.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>transit</td>
<td>Boolean</td>
<td>True if respondent uses transit as primary mode to work and/or school</td>
</tr>
<tr>
<td>outside_zone</td>
<td>Boolean</td>
<td>True if respondent’s home address is more than 2000 feet away from a Reach service area</td>
</tr>
<tr>
<td>white</td>
<td>Boolean</td>
<td>True if respondent identifies solely as white</td>
</tr>
<tr>
<td>woman</td>
<td>Boolean</td>
<td>True if respondent identifies as a woman</td>
</tr>
<tr>
<td>age</td>
<td>Ordinal</td>
<td>6 age categories, with higher values for categories representing higher age</td>
</tr>
<tr>
<td>income</td>
<td>Ordinal</td>
<td>13 household income level categories, with higher values for categories representing higher income</td>
</tr>
<tr>
<td>education</td>
<td>Ordinal</td>
<td>6 education level categories, with higher values for categories representing more years in education</td>
</tr>
<tr>
<td>marta_length</td>
<td>Ordinal</td>
<td>4 MARTA riding history categories, with higher values for categories representing longer and more frequent riding</td>
</tr>
<tr>
<td>satisfaction</td>
<td>Ordinal</td>
<td>5 levels of satisfaction, arranged similarly to a Likert-type scale, centered on a neutral category</td>
</tr>
<tr>
<td>kids_in_household</td>
<td>Discrete</td>
<td>Numerical input for number of persons under the age of 18 in the respondent’s household</td>
</tr>
<tr>
<td>people_in_household</td>
<td>Discrete</td>
<td>Numerical input for number of persons in the respondent’s household</td>
</tr>
</tbody>
</table>
Figure 31. Correlation matrix for variables to be used in model selection.

5.1 Model selection

Seven algorithms were evaluated with the modeling dataset using a machine learning-style pipeline. The algorithms evaluated were support vector machine classifier (SVC), k-nearest neighbors classifier, decision tree, random forest, Gaussian naïve Bayes classifier, logistic regression, and a multi-layer perceptron (MLP) classifier. The evaluation metrics used were accuracy, precision, recall, the F1-score (i.e., the harmonic mean of the precision and recall), and the area under the curve of the receiver operating characteristic (AUC). McFadden’s likelihood ratio index, the pseudo R-squared, is later applied to the
logistic regression to evaluate its performance but was not part of the machine learning pipeline. The models were called from scikit-learn and evaluated using five-fold cross validation with the evaluation metrics listed above as scorers. From the machine learning evaluation metrics, the logistic regression displayed the highest performance, as seen in Table 4, with the highest accuracy of 0.88, largest AUC of 0.83, and second highest F1-score of 0.48.

**Table 4. Fivefold cross validation scores for the seven algorithms.**

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Accuracy</th>
<th>AUC</th>
<th>F1</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVC</td>
<td>0.855</td>
<td>0.790</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>KNN</td>
<td>0.846</td>
<td>0.647</td>
<td>0.221</td>
<td>0.449</td>
<td>0.162</td>
</tr>
<tr>
<td>Decision Tree</td>
<td>0.817</td>
<td>0.684</td>
<td>0.446</td>
<td>0.422</td>
<td>0.496</td>
</tr>
<tr>
<td>Random Forest</td>
<td>0.878</td>
<td>0.773</td>
<td>0.426</td>
<td>0.719</td>
<td>0.320</td>
</tr>
<tr>
<td>Naïve Bayes</td>
<td>0.842</td>
<td>0.814</td>
<td>0.487</td>
<td>0.493</td>
<td>0.509</td>
</tr>
<tr>
<td>Logistic Regression</td>
<td>0.884</td>
<td>0.826</td>
<td>0.480</td>
<td>0.716</td>
<td>0.364</td>
</tr>
<tr>
<td>MLP</td>
<td>0.863</td>
<td>0.713</td>
<td>0.439</td>
<td>0.614</td>
<td>0.363</td>
</tr>
</tbody>
</table>
Figure 32. Confusion matrices for the seven algorithms.
Figure 32 depicts the confusion matrix for each of the seven evaluated algorithms. Note that a confusion matrix requires that an algorithm that estimates likelihoods or probabilities have a “decision threshold” wherein a likelihood or probability greater than the threshold is the decision corresponding to 1, while less than is the decision corresponding to 0. This interpretation of model predictions, such as that of logistic regression, is used in this thesis for only the purposes of constructing these confusion matrices. From the confusion matrices, logistic regression being one of the more conservative algorithms was clear, in terms of predicting that a user is a rider. In the precision-recall tradeoff, the desired model will have more precision for this application, since the class being predicted is rare in the sample. In this respect, logistic regression performed well. Based on the findings of the cross validation and the confusion matrices, logistic regression was selected as the appropriate model.

5.2 Logistic regression

The logistic regression model implementation used was from the “statsmodels” Python package. By default, the package uses Newton’s method, also called Newton-Raphson, for numerical optimization. The results from the initial model specification are presented as follows. The optimization converged in eight iterations. McFadden’s likelihood ratio index, henceforth called the pseudo-R², is 0.3242. The log-likelihood is -133.02, the null log-likelihood is -196.84, and the p-value of the likelihood ratio test is 5.202e-22, indicating that the model predicts the target variable significantly better than the null model.
The coefficients, standard errors, and significance of each variable are shown in Table 5. Note that the constant, age, being a transit user, living outside of a service area, and overall satisfaction with MARTA services appear to be significant in the model. The signs of the coefficients are consistent with what was expected for the significant variables. See CHAPTER 6 Discussion for further elaboration on the model coefficients, the revealed influential factors in ODT adoption, and other aspects of this model and subsequent model specifications developed from it which are discussed later in this section. Notice that neither age nor income are significant.

Also notice the coefficients and signs of the number of people living in the respondent’s household and the number of minors living in the respondent’s household. The coefficients are close in magnitude and opposite in sign, and both variables have the same unit and same order of magnitude. The correlation matrix in Figure 31, although showing a relatively low coefficient of correlation, indicated that a collinearity problem could exist between these two variables. Combined with what the coefficients show, the case for dropping one of the two becomes clearer, and the number of people in the respondent’s household is dropped in subsequent model specifications as it is less significant.
Table 5. Logistic regression coefficients, standard errors, and significance for initial model specification.

| Variable name                              | Coefficient | Std error | P > |z| |
|--------------------------------------------|-------------|-----------|-----|---|
| McFadden’s pseudo R²                       |             |           | 0.3242 | |
| Log-likelihood                             |             |           | -133.02 | |
| Null log-likelihood                        |             |           | -196.84 | |
| p-value of likelihood ratio test           |             |           | 5.202e-22 | |
| Constant                                   | -2.7369     | 1.145     | 0.017 | |
| Transit user                               | 2.2759      | 0.437     | 0.000 | |
| Lives outside service area                 | -2.4008     | 0.404     | 0.000 | |
| White                                      | 0.1199      | 0.390     | 0.759 | |
| Woman                                      | -0.2563     | 0.346     | 0.459 | |
| Age                                        | -0.3463     | 0.132     | 0.009 | |
| Income                                     | -0.0696     | 0.057     | 0.222 | |
| Education                                  | 0.2392      | 0.200     | 0.231 | |
| Length of MARTA ridership                  | -0.0471     | 0.293     | 0.872 | |
| Overall satisfaction with MARTA            | 0.6997      | 0.164     | 0.000 | |
| Number of minors in household              | -0.1962     | 0.155     | 0.206 | |
| Number of people in household              | 0.1929      | 0.220     | 0.381 | |

Adjusting the ordinal variables to be represented by dummy variable-encoded nominal variables resulted in better model performance, as measured by pseudo-R². The highest performance gain came from adjustment of the income variable. Adjusting other
variables either did not result in a high enough performance gain to justify the change or did not lead to any new significant variables being formed. As such, the income variable was re-encoded to consist of nominal categories “low-income”, “middle-income”, and “high-income”, with the thresholds being those making below $50,000 per year, those making at least $50,000 and below $150,000 per year, and those making at least $150,000 per year, respectively. The new correlation matrix is shown in Figure 33, showing that collinearity was likely not a problem with the variables in this model, with no coefficients exceeding an absolute value of 0.57.

Figure 33. Correlation matrix for model with nominal income variable.
The middle-income dummy variable was dropped and the low- and high-income variables retained. For this model, the pseudo-$R^2$ is 0.3320. The log-likelihood is -131.49, the null log-likelihood is -196.84, and the p-value of the likelihood ratio test is 1.249e-22. Notice that the pseudo-$R^2$ and p-value are both higher and lower, respectively, for this model compared to the initial model, indicating an improvement in model fit. The coefficients, standard errors, and significance of each variable are shown in Table 6.

Table 6. Logistic regression coefficients, standard errors, and significance for model with nominal income variables.

| Variable name                              | Coefficient | Std error | P > |z| |
|--------------------------------------------|-------------|-----------|-----|---|
| Constant                                   | -4.4550     | 1.222     | 0.000          |
| Low income                                 | 0.9543      | 0.423     | 0.024          |
| High income                                | -0.2766     | 0.549     | 0.614          |
| Transit user                               | 2.1144      | 0.437     | 0.000          |
| Lives outside service area                 | -2.3161     | 0.397     | 0.000          |
| White                                      | 0.2253      | 0.394     | 0.567          |
| Woman                                      | -0.2953     | 0.346     | 0.393          |
| Age                                        | -0.3407     | 0.131     | 0.009          |
| Education                                  | 0.3309      | 0.199     | 0.096          |
The significant variables in this model are the constant, having low income, being a transit user, living outside the service area, age, and overall satisfaction with MARTA service. The signs for the coefficients on the low-income and high-income variables are as expected, with having low income being positively correlated with being a Reach rider, while having high income is negatively correlated. The coefficient of the constant has decreased considerably from the initial model specification.

The effect on the model of representing income as a binary Boolean indicating whether the respondent was in a low-income household was explored next. This representation has the potential to be more interpretable than a representation where the nominal income variable has three categories, like in the previously discussed model. The decrease in pseudo-$R^2$ is small, with the new pseudo-$R^2$ being 0.3314. The log-likelihood is -131.61, the null log-likelihood is -196.84, and the p-value of the likelihood ratio test has improved compared to previous models to 3.772e-23. The coefficients, standard errors, and significance of each variable are shown in Table 7.
Table 7. Logistic regression coefficients, standard errors, and significance for model with income variable re-encoded as a Boolean indicating low income.

| Variable name                        | Coefficient | Std error | P > |z| |
|--------------------------------------|-------------|-----------|-----|---|
| Constant                             | -4.4354     | 1.225     | 0.000 |
| Low income                           | 1.0202      | 0.407     | 0.012 |
| Transit user                         | 2.1489      | 0.433     | 0.000 |
| Lives outside service area           | -2.3126     | 0.397     | 0.000 |
| White                                | 0.2018      | 0.391     | 0.606 |
| Woman                                | -0.2684     | 0.342     | 0.432 |
| Age                                  | -0.3466     | 0.130     | 0.008 |
| Education                            | 0.3183      | 0.198     | 0.107 |
| Length of MARTA ridership            | -0.0224     | 0.292     | 0.939 |
| Overall satisfaction with MARTA      | 0.6894      | 0.162     | 0.000 |
| Number of minors in household        | 0.0276      | 0.164     | 0.866 |

The significant variables in this model are the constant, having low income, being a transit user, living outside of a service area, age, and overall satisfaction with MARTA service. The signs and magnitudes of the coefficients have not changed significantly from the previous model.
Finally, the effect on the model of doing away with all insignificant variables was explored. The removed variables are identifying as white, identifying as a woman, education, length of MARTA ridership, and number of minors in the household. The resulting model has a small decrease in pseudo-$R^2$ compared with the previously specified model, with the new pseudo-$R^2$ being 0.3209. The log-likelihood is -133.67, the null log-likelihood is -196.84, and the p-value of the likelihood ratio test has improved considerably compared to previous models to 1.422e-25. The coefficients, standard errors, and significance of each variable are shown in Table 8.

**Table 8. Logistic regression coefficients, standard errors, and significance for model with insignificant variables dropped.**

| Variable name                        | Coefficient | Std error | P > |z| |
|--------------------------------------|-------------|-----------|-----|---|
| Constant                             | -3.0605     | 0.544     | 0.000 |
| Low income                           | 0.6279      | 0.349     | 0.072 |
| Overall satisfaction with MARTA      | 0.6652      | 0.159     | 0.000 |
| Transit user                         | 1.9153      | 0.361     | 0.000 |
| Lives outside service area           | -2.2450     | 0.386     | 0.000 |
| Age                                  | -0.3233     | 0.122     | 0.008 |

All coefficient signs and magnitudes are within the realm of what would be expected. Notice that having low income is not significant in this model. Further discussion
of the 11 variables explored, the different model specifications, and what they mean in the context of this pilot and future ODT service are in 6.2 Rider or non-rider.
CHAPTER 6. DISCUSSION

6.1 Characteristics of riders and non-riders

6.1.1 Comparison of the two user groups

Overall, riders tended to be younger, had less education, lower income, and were more likely to identify as black than non-riders. Respondents less than 35 years old represented 184 out of 548 non-riders (33.6%) and 66 out of 142 riders (46.5%), for a difference of 12.9% between the two groups. These data show is that those in the older age groups were more likely to be non-riders, while those in the younger age groups were more likely to be riders. 355 out of 524 non-riders (67.7%) have graduated college, while 66 out of 129 riders (50.4%) have done the same, for a difference of 17.3% between the two groups. Little difference exists between the gender distribution of the groups. Both displayed a roughly even split between men and women, while those with non-binary and self-described genders were not well-represented. The differences between the two groups in household income and race / ethnicity are much more pronounced than for the other demographic characteristics. The majority of rider respondents came from low-income households, at 80 out of 141 (56.7%), and the majority identified as black, at 76 out of 130 (58.5%) of respondents. Compare these figures to those of non-riders, with 165 out of 550 (30.0%) respondents reporting coming from a low-income household, and 177 out of 512 (34.6%) respondents identifying as black. 225 non-rider respondents identified as white (43.9%), which is a significantly higher proportion of respondents than the 31 out of 130 (23.8%) riders who identified as white.
Riders also were more likely to use transit modes as a primary mode to access work / school, less likely to be infrequent riders of MARTA and more likely to be frequent riders, and more satisfied with overall MARTA service than non-riders. 51 out of 65 rider respondents (78.5%) reported riding transit at least 4 times per week to access work / school prior to the introduction of Reach. Compare to 203 out of 437 (46.5%) non-rider respondents reporting taking transit at least 4 times per week to access work / school. 75 out of 106 (70.8%) of rider respondents characterize their MARTA riding habits as long-term frequent riding, while 255 out of 598 (42.6%) of non-rider respondents characterizing their riding habits in the same way. Possibly related to this trend is the lower reported satisfaction among non-riders, with only 56 out of 576 responding non-riders (9.7%) indicating very high satisfaction with overall MARTA services. Contrast this satisfaction rate to responding riders, of which 69 out of 194 (35.6%) indicated very high satisfaction. 172 out of 194 rider respondents (88.7%) reported feeling at least neutral about overall MARTA service, while 440 out of 576 non-rider respondents (76.4%) had the same feelings. The difference in these figures is not as wide as for very high satisfaction, indicating that all users were likely to at least have neutral feelings, i.e., not harbor negative feelings, about MARTA. The broader implication could be that to even be interested enough to sign up for Reach, a potential user must at least feel indifferent towards MARTA, and a negative opinion about MARTA would likely lead to a potential user not being interested in new MARTA service.

6.1.2 Rider travel behavior

Figure 9 shows the primary mode, as defined in 3.1.2 Processing the results, for rider respondents on trips to or from work / school. Clearly, most respondents primarily
used transit before Reach and continued to use transit during the Reach pilot period. Note, however, that this primary mode figure does not indicate the proportion of trips that the respondent group takes on a certain mode nor does it indicate any sort of likelihood or probability. Figure 10 shows 532 mode selections among 272 trips, which is 307 trips less the 35 selections indicating that the trip would not have been taken absent Reach, indicating about 2 modes per trip on average. The primary mode figure does not illustrate this multimodality and was not intended to. The figure could be misunderstood to show a deflated apparent proportion of automobile trips replaced by Reach, since multimodal trips involving automobiles were not captured in the primary mode data. Figure 10 shows that 114 out of 307 trips reported by various rider respondents would have involved an automobile-based mode, and Reach replaced that portion of the trip for the respondent. This different angle on mode usage among rider respondents indicates that Reach replaced more vehicle miles traveled and/or automobile-based trips than Figure 9 could be misunderstood to suggest.

6.1.3 Rider satisfaction

Rider respondents indicated a higher degree of satisfaction with Reach than with MARTA service overall. 181 out of 192 respondents (94.3%) reported being at least satisfied with Reach, and 186 out of 192 respondents (96.9%) felt at least neutral. Compare these figures to respondent satisfaction with MARTA service overall, with 146 out of 194 respondents (75.3%) indicating at least being satisfied and 172 out of 194 (88.7%) feeling at least neutral. See Figure 12 and Figure 13 for the proportions of each response category to the MARTA service overall and MARTA Reach satisfaction questions.
The reported degree of willingness to recommend ODT services and the hypothetical willingness to ride ODT in the future both indicate that riders had strongly positive opinions about ODT after riding Reach. 165 out of 194 (85.1%) respondents indicated that they “definitely would” recommend ODT services to others. 157 out of 194 (80.9%) respondents indicated that they would ride ODT services more often in the future. Including 29 respondents who indicated they would ride ODT in the future with “about the same” frequency, 186 out of 194 respondents (95.9%) would ride ODT at least the same amount or more in the future. These figures indicate that a high degree of latent demand for ODT services may exist.

6.1.4 Non-rider reasons for not riding

As shown in Figure 26, most non-rider respondents indicated one of their reasons for not riding was the lack of service in places they wanted to travel, with 426 out of 561 respondents (75.9%) choosing “Reach did not go where I need to go” on the “reasons for not riding” question of the non-rider survey. Related to this choice was the choice indicating lack of service at times they wanted to travel, represented by the “Reach doesn't operate late enough or early enough” answer choice, which 97 respondents (17.3%) chose. Note that this question allowed multiple answers. Expansion of service, both in service area and operating hours, appears to be a likely way to increase the market share of ODT.

Rider education and training, or lack thereof, also appeared to pose a challenge to the service, as 137 respondents (24.4%) chose “I did not understand how to use the service”. Related to this challenge are the following responses: 35 respondents (6.2%) chose “I had issues with the app (could not install the app on my phone, etc.)” and 25
respondents (4.5%) chose “I had issues with the service (requested a ride but it never showed up, pickup took too long, etc.)”. These responses may indicate issues with useability of the app and with operator training.

Generally, the results suggest that alternatives did not play a major role in non-riders’ decisions to not try the service. Only 12 respondents indicated that they had cheaper options, and the emergent categories indicating the respondent would rather use a different specific mode were small with 6 responses in each of “Had access to a car” and “Would rather walk instead”. However, note that these categories emerged from manual encoding of free-form answers solicited when respondents chose the “Other reason” choice. Had these two choices been choices in the original answer set, more respondents may have chosen them. Their mere existence as an emergent pattern in the free-form responses could suggest that car access and preference for walking are latent variables.

6.2 Rider or non-rider logistic regression

6.2.1 Significant variables

Table 8 presents the coefficients, standard errors, and significance of each of the five significant variables identified while building the rider / non-rider logistic regression model. Table 9 shows the model with Euler’s constant exponentiated using the model coefficients, which provides the change in odds ratio of success to failure per unit change in the variable [27], making the coefficient more interpretable. Note that an odds ratio of 1 corresponds to 50% probability for both success and failure. Specifically in this model, success and failure refer to being a rider and being a non-rider, respectively. Odds ratios increasing by less than 1 corresponds to a decrease in the odds of being a rider relative to
the odds of being a non-rider, while an odds ratio *increasing* by greater than 1 corresponds to an *increase* in the odds of being a rider relative to the odds of being a non-rider. In other words, an $e^\beta$ less than 1 is the result of a negative coefficient $\beta$, while positive coefficients $\beta$ have $e^\beta$ greater than 1, where $e^\beta$ is the odds ratio and $\beta$ is the log-odds, the coefficients in the model. The inverse odds ratio provides the change in odds with respect to being a non-rider per unit increase in the variable.

### Table 9. Five-variable model with exponentiated Euler's constant using model coefficients.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Coefficient $\beta$</th>
<th>Odds ratio $e^\beta$</th>
<th>Inverse odds ratio $\frac{1}{e^\beta}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3.0605</td>
<td>0.04686426</td>
<td>21.3382236</td>
</tr>
<tr>
<td>Low income</td>
<td>0.6279</td>
<td>1.87367173</td>
<td>0.53371142</td>
</tr>
<tr>
<td>Overall satisfaction with MARTA</td>
<td>0.6652</td>
<td>1.94487946</td>
<td>0.51417068</td>
</tr>
<tr>
<td>Transit user</td>
<td>1.9153</td>
<td>6.78897518</td>
<td>0.14729764</td>
</tr>
<tr>
<td>Lives outside service area</td>
<td>-2.2450</td>
<td>0.10592754</td>
<td>9.44041556</td>
</tr>
<tr>
<td>Age</td>
<td>-0.3233</td>
<td>0.72375669</td>
<td>1.38167979</td>
</tr>
</tbody>
</table>

Examining the odds ratios, the “transit user” variable stands out as strongly affecting being a rider. Recall that “transit user” is a binary Boolean variable indicating whether the respondent uses transit at least four times per week to access work or school, and potentially taking multimodal trips involving transit. Previously, this usage pattern was defined as the respondent’s “primary mode”, and the transit user variable indicates whether the respondent’s primary mode is transit. As such, this odds ratio can be interpreted to
mean the following: holding all other variables constant, a potential Reach user who also uses transit as their primary mode of transportation has 579% higher odds of becoming a Reach rider than a potential Reach user who does not use transit as their primary mode of transportation.

Examining the inverse odds ratios, the “lives outside service area” variable appears to have a strong effect on being a non-rider. Recall that “lives outside service area” is a binary Boolean variable indicating whether the respondent lives outside of a Reach service area plus a 2000-foot buffer to capture respondents close to a service area. The inverse odds ratio can be interpreted to mean that with all other variables held constant, a potential Reach user living outside of a service area has 844% higher odds of being a non-rider than a potential Reach user living within a service area. The converse of the inverse of this odds ratio can be expressed to make clearer the strong effect residing within a service area has on user behavior: a potential Reach user living within a service area has 844% higher odds of being a rider than a potential user living outside of a service area. Per Figure 26 and previous discussion in 6.1.4 Non-rider reasons for not riding, 75.9% of respondents indicated that they did not try riding Reach because the service was not available in places they wanted to access. Taking these two findings together, the strong effect on enticing interested users into trying the service by simply offering a larger service area or more service areas becomes apparent. Note that these findings cannot support a conclusion such as “if you build it, they will come” or any other broadly-based statements about travel behavior within a population, as all respondents were at least interested enough in Reach to sign up for the service and complete a survey. However, although the data and model are limited in this way, the non-rider market is potentially quite large, as partially evidenced
by the imbalance between the rider and non-rider classes as seen in Figure 27, with riders representing only 14.5% of respondents. Put another way, only 14.5% of potential users who were interested enough in the service to sign up and take a survey tried riding Reach, indicating the presence of a substantial number of non-riders who could be converted to riders through expanded service.

“Low income” is the weakest of the three binary Boolean variables, and indicated whether the respondent’s household makes below $50,000 per year. The odds ratio can be interpreted to mean that a respondent has 187% higher odds of being a rider, all other variables kept constant, if they are in a low-income household.

“Overall satisfaction with MARTA” and “Age” are ordinal categorical variables, and the coefficient can be multiplied by the category code, causing the variable to behave nominally similarly to a discrete variable. “Overall satisfaction with MARTA” indicates the respondent’s satisfaction level with all MARTA services, including but not limited to bus, rail, and paratransit. The satisfaction categories are coded from 0 to 4, with 4 representing the highest satisfaction level and 0 the lowest. The odds ratio can be interpreted to mean that with each jump to a higher satisfaction category, the respondent has 95% higher odds of being a rider than of being a non-rider, all other variables kept constant. Thus, a satisfaction in the 4th category representing highest satisfaction would mean the respondent has 678% higher odds of being a rider than of being a non-rider, all other variables kept constant. This finding may suggest that Reach did not bring in new riders to the MARTA system overall and may not have the potential to do so. The “Age” variable behaves similarly but in the opposite direction, causing respondents to have a higher likelihood of being non-riders the higher among the categories to which the
respondent belongs. Age is coded from 0 to 5, with 5 representing those 65 and older and 0 representing those 18 to 24 years old, with roughly equally spaced categories between them. Moving up one category in age leads to 38% higher odds of being a non-rider than of being a rider, all other variables held constant. At the 5th category, the respondent would have 591% higher odds of being a non-rider than of being a rider. Differences with European ODT evaluations that showed that higher age is linked with higher rates of ODT riding [1][2][4][5] may potentially be attributed to several factors, such as lower feelings of safety and higher technological barriers (i.e., calling a ride over the phone may not have been as convenient or as well-advertised as using the mobile app) in the MARTA Reach context and generally in the North American context.

The coefficient of the constant, and the calculated inverse odds ratio, indicates that at a baseline, potential users have much higher odds of being a non-rider. With all other variables held constant, a potential user “starts with” or “naturally has” 2034% higher odds of being a non-rider. This very high inverse odds ratio indicates the possibility of a strong bias against taking Reach among respondents but may simply be an effect of the imbalanced classes and the relative rarity of being a rider.

6.2.2 Insignificant variables

Several variables turned out to be insignificant, contrary to findings from previous experiences with ODT and/or contrary to intuition. Recall from Table 7 that the variables “White”, “Woman”, “Education”, “Length of MARTA ridership”, and “Number of minors in household” were not significant in the model specified just prior to the five-significant-variables only model. “White” and “Woman” were binary Boolean variables. “White”
indicated whether the respondent identified as white, while “Woman” indicated whether the respondent identified as a woman. Through this binary categorization, white and women represented the respondent’s race / ethnicity and gender identity. In past experiences with ODT, both race and gender, especially identifying as white [3] or black [19][23] and identifying as a woman [2][3][4][9][19][23], were significant factors in ODT adoption.

Education was also found to be significant in ODT adoption in two other evaluations of an ODT systems explored in CHAPTER 2 Literature Review. The Ebuxi evaluation by Thao, et. al., found that better educated people were more likely to adopt ODT, possibly because of a greater understanding of the negative effects on climate change that transportation can have [1]. However, in this thesis, education was not significant, similarly to what was found in the SmaRT Ride evaluation [22]. Race / ethnicity, being a transit user, and income all had modest correlation to education according to the correlation matrices shown in Figure 29 and Figure 31. Education was possibly the weakest variable among these other variables and simply was “robbed” of its power by the others.

“Length of MARTA ridership” and “Number of minors in household” could be reasoned to influence ODT adoption but were insignificant in the model. Length of MARTA ridership is modestly correlated with being a transit user according to the correlation matrices, and in theory the two variables are measuring the same travel behavior – the degree to which the respondent is dependent or reliant on transit, or the degree of the frequency with which the respondent chooses to use transit – but from different perspectives. Due to this similarity, the length of MARTA ridership variable likely was “overpowered” by the variable directly measuring transit usage. The number of minors in
household had no similar variable remaining after the number of people in household was dropped from the models. The insignificance of this variable could be explained by the lack of variable directly measuring access to an automobile. Likely, those with access to a car and children were not likely to use ODT, but those without access to a car are not affected in terms of their ODT adoption by having children. The insignificance of the number of minors in household contrasted with the significance of the variable in the SmaRT Ride evaluation [22], but that study asked about children younger than 6, whereas the surveys developed for this thesis asked about minors younger than 18. Possibly, had the age cutoff been lower, the variable would have been significant like in the SmaRT Ride evaluation.

Several differences between this evaluation and past evaluations could exist due to differing cultural and historical contexts between Europe and North America. Variables such as race / ethnicity, education, and gender appear to behave significantly differently depending on the local context.
CHAPTER 7. CONCLUSION

This thesis studied the factors influencing ODT adoption and the characteristics of ODT riders and interested-non-riders. Using data collected from a series of surveys, the characteristics of each group were obtained and analyzed. These characteristics were used to build a binary logit model estimating the likelihood of the user being a rider or a non-rider. ODT riders were found to be younger black, low-income transit users who are very satisfied with MARTA service and live inside of a Reach service area, while non-riders were found to be white, middle- or high-income drivers and transit users who feel neutral about MARTA service and live outside of a Reach service area.

7.1 Shortcomings and future research

This evaluation did not directly ask respondents to indicate their level of access to an automobile. While this omission was intentional in the survey design, analysis revealed that access to an automobile was possibly a latent variable and may have improved model fit had the variable been explicit. Future evaluations attempting to classify users based on ODT adoption should include an automobile access variable.

Furthermore, this evaluation limited itself in scope to people who were interested enough in ODT to sign up for MARTA Reach. Essentially, the population can be characterized as falling into three groups: 1) the riders and 2) non-riders, also referred to as the users in this study and of which the respondents are a subset, and 3) the potential users, who are the people who did not sign up for Reach. These “uninterested masses”, the complement of those who signed up, were not part of this evaluation in any way. This
design was intentional, as the potential user group is far larger than the users, are highly heterogenous, and would likely need to be further segmented to be an effective part of an ODT evaluation, and the data, human, and computational resources did not exist to undertake this further analysis. Future studies that have access to data from a non-rider group and have the resources to undertake analysis of the wider uninterested population should do so, as this group could reveal insights into what factors affect interest in ODT, rather than just adoption given interest.

7.2 Impact and context

The findings from this study are important to understanding factors that affect ODT adoption among ODT-interested populations in similar social-cultural and place-contexts to that of the Greater Atlanta area. Over-generalizing or over-simplifying the specific applicability of the findings would be hazardous, as transit systems operate in a highly human context. This thesis and the evaluations referenced here are not necessarily repeatable experiments but momentary glimpses into a complex system of human need, desire, and its fulfillment or lack thereof.

ODT has the potential to play a key role in bringing back riders to transit systems recovering from the COVID-19 pandemic and to better serve places with poor fixed-route coverage. What has been shown here is that ODT may have great potential for expansion and adoption among the transit-riding public in Greater Atlanta. Those who rode the service expressed highly positive sentiments about it and planned to ride more frequently. The non-riders overwhelmingly did not ride simply because the service was not available in their area. The findings here also affirm that ODT adoption factors are considerably
different across contexts, spatially, temporally, socially, and culturally. In terms of ODT’s ability to attract new transit users, the findings here shows that regular transit riders will take ODT instead of other modes, including private automobiles, but that people who have never used transit before are unlikely to be attracted to it because of the presence of ODT. Note that this potential for opening new markets may exist, and the study was not designed to show it, but the data here cannot support such a claim. However, ODT is a mode that shows great potential for making transit more attractive and useful.
A.1 Rider surveys

A.1.1 Registration

Thanks for registering for MARTA Reach. As part of our efforts, we'd like to have you participate in a few short surveys during the pilot project. Your answers to these surveys are very important to the MARTA Reach team. MARTA and Georgia Tech will be using your answers to evaluate the success of Reach and how well this pilot served customers like you. Please only take the survey if you are 18 years or older. We greatly appreciate you taking the time to fill out this survey.

www.itsmarta.com/reach

To request this information in an accessible format or another language, please call 404-848-4037.

Your rider ID is: ${e://Field/rider_id}

Please select your primary language spoken at home.

▼ English (1) ... Other (7)
How well do you speak English?

○ Fluent (1)

○ Advanced (2)

○ Intermediate (3)

○ Basic (4)

○ I do not speak English (5)

What language do you speak at home?

__________________________________________________________________________
Considering your trips to work / school, please indicate how often you use each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th></th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>With others in car, van (2)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Public transit (MARTA, CobbLinc, etc) (3)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Mode</td>
<td>Options</td>
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<td></td>
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<td></td>
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<td>-------------------------------</td>
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</tr>
<tr>
<td>Taxi, Uber, Lyft, etc.</td>
<td>(4)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bicycle, Scooter</td>
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<tr>
<td>Walk</td>
<td>(6)</td>
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<tr>
<td>Paratransit (Mobility)</td>
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<tr>
<td>Other (please specify)</td>
<td>(8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Considering your trips to other locations (social, shopping, etc), please indicate how often you use each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th>Mode of Travel</th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>With others in car, van (2)</td>
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<td>○</td>
<td>○</td>
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<tr>
<td>Public transit (MARTA, CobbLinc. etc) (3)</td>
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<tr>
<td>Taxi, Uber, Lyft, etc.</td>
<td>✔️ ◯ ◯ ◯ ◯ ◯ ◯ ◯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle, Scooter (5)</td>
<td>✔️ ◯ ◯ ◯ ◯ ◯ ◯ ◯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Walk (6)</td>
<td>✔️ ◯ ◯ ◯ ◯ ◯ ◯ ◯</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paratransit (Mobility) (7)</td>
<td>✔️ ◯ ◯ ◯ ◯ ◯ ◯ ◯</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>✔️ ◯ ◯ ◯ ◯ ◯ ◯ ◯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which gender do you identify as?

○ Man (1)

○ Non-binary (2)

○ Woman (3)

○ Prefer to self-describe: (4)

________________________________________________________________________________

○ Prefer not to answer (5)
In which of the following categories does your age fall?

- 18 to 24 (1)
- 25 to 34 (2)
- 35 to 44 (3)
- 45 to 54 (4)
- 55 to 64 (5)
- 65 and older (6)
- Prefer not to answer (7)
Which of the following categories best represents your total annual household income before taxes?

- Under $10,000 (1)
- $10,000 to $14,999 (2)
- $15,000 to $19,999 (3)
- $20,000 to $24,999 (4)
- $25,000 to $29,999 (5)
- $30,000 to $34,999 (6)
- $35,000 to $39,999 (7)
- $40,000 to $49,999 (8)
- $50,000 to $74,999 (9)
- $75,000 to $99,999 (10)
- $100,000 to $149,999 (11)
- $150,000 to $199,999 (12)
○ $200,000 or more (13)

○ Prefer not to answer (14)
Which of the following describes you? Select all that apply.

☐ Black or African American (1)

☐ White or Caucasian (2)

☐ Hispanic or Latino (3)

☐ Asian (4)

☐ Indigenous American, Native American or Alaskan Native (5)

☐ Native Hawaiian or other Pacific Islander (6)

☒ Prefer not to answer (7)

☐ Other (please specify): (8)
What is the highest level of education you have completed?

- Less than 9th grade (1)
- From 9th grade to 12th grade (no diploma) (2)
- High school graduate (3)
- Some college but no bachelor's degree (4)
- Bachelor's degree (5)
- Graduate work and postgraduate degree (6)
- Prefer not to answer (7)

How many persons, including yourself and any children, are in your household? Number must be at least 1.
How many of these persons in your household are children under the age of 18?

________________________________________________________________________

What is your home address? We will not share this information and no one will contact you. This information will help the MARTA Reach team examine the success of the pilot.

________________________________________________________________________

Page Break

How long have you been using MARTA?

○ Long-time regular rider (1)

○ Long-time infrequent rider (2)

○ Began riding recently (3)

○ Never ridden MARTA before (4)

If you are willing to share your Breeze Card number, we will be able to look up how many trips you've taken with MARTA before, during, and after the Reach pilot. We will not share
this information with anyone and we cannot access your financial information or other personal details through your Breeze Card number.

Enter 20-digit Breeze Card number in format XXXXXXXXXXXXXXXXXXXXXX. You may upload a photo of the back of your Breeze Card in the next question instead of writing down the number if you would prefer. We will not share this information with anyone.

Please upload a photo of the back of your Breeze Card if you did not write down your Breeze Card number above.
How did you hear about Reach?

- MARTA marketing materials (1)
- Word of mouth (2)
- Saw Reach vehicle and looked up the service (3)
- Saw Reach app and looked up the service (4)
- Other (please specify): (5)

Thank you for completing the survey. Below is space if you would like to make any comments about MARTA Reach, such as your expectations for the service or how the service may impact your travel.

________________________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

End of Block: Default Question Block
Thanks for using MARTA Reach. As part of our efforts, we'd like to have you participate in a few short surveys during the pilot project. Your answers to these surveys are very important to the MARTA Reach team. MARTA and Georgia Tech will be using your answers to evaluate the success of Reach and how well this pilot served customers like you. We greatly appreciate you taking the time to fill out this survey.
If you have not taken the registration survey, please do so at this time at the link below:
$\{e://Field/rider_id\}"\text{Registration survey}$

To request this information in an accessible format or another language, please call 404-848.4037.

Your rider ID is: $\{e://Field/rider_id\}$

Your trip ID is: $\{e://Field/trip_id\}$
On this one-way trip that you are making now, which modes of service are a part of this trip, in addition to MARTA Reach (including parts of the trip that you have already made)? Select all that apply.

- □ MARTA Bus (1)
- □ MARTA Mobility (2)
- □ MARTA Rail (3)
- □ Drive myself (4)
- □ Ride with someone (5)
- □ Taxi / Uber / Lyft (6)
- □ Walk (7)
- □ Bike (8)
- □ E-Scooter / Bikeshare (9)
Other (please specify): (10)
How would you make this trip if MARTA Reach was not available? Select all that apply.

- [ ] Would not make this trip (1)
- [ ] MARTA Bus (2)
- [ ] MARTA Mobility (3)
- [ ] MARTA Rail (4)
- [ ] Drive myself (5)
- [ ] Ride with someone (6)
- [ ] Taxi / Uber / Lyft (7)
- [ ] Walk (8)
- [ ] Bike (9)
- [ ] E-Scooter / Bikeshare (10)
Other (please specify): (11)

Page Break
Where are you traveling TO on this one-way trip?

- Work (1)
- School (2)
- Grocery shopping (3)
- Retail shopping (4)
- Social trip (visiting friend; movie; dinner; etc.) (5)
- Special event (sporting events; concert; etc.) (6)
- Medical facility (7)
- Airport (for travel) (8)
- Home (9)
- Other (please specify): (10)

__________________________________________________
Where are you traveling FROM on this one-way trip?

- Work (1)
- School (2)
- Grocery shopping (3)
- Retail shopping (4)
- Social trip (visiting friend; movie; dinner; etc.) (5)
- Special event (sporting events; concert; etc.) (6)
- Medical facility (7)
- Airport (for travel) (8)
- Home (9)
- Other (please specify): (10)

__________________________________________________
Where is $Q3/ChoiceGroup/SelectedChoicesTextEntry$ located? (For large, easily identifiable locations, just write in the name - Ex: Airport, Perimeter Mall, GWCC, MB Stadium)

Street address OR nearest street and cross street:

Where is $Q4/ChoiceGroup/SelectedChoicesTextEntry$ located? (For large, easily identifiable locations, just write in the name - Ex: Airport, Perimeter Mall, GWCC, MB Stadium)

Street address OR nearest street and cross street:

If you have not taken the Registration survey yet (questions about how often you use MARTA and your demographics), please do so at the link below.

End of Block: Default Question Block
A.1.3 Evaluation

Start of Block: Default Question Block

We greatly appreciate your participation in past surveys with MARTA Reach. The following survey will ask about your experience with us over the past couple of months. Please only take this survey if you are 18 years or older. Thank you for taking the time to fill out this survey.

Your email address is $\{e://Field/Email\}$. If this is not correct, please enter your email address below:

To request this information in an accessible format or another language, please call 404-848-4037.
How satisfied are you with MARTA Reach service?

- Very satisfied (1)
- Satisfied (2)
- Neither satisfied nor dissatisfied (3)
- Dissatisfied (4)
- Very dissatisfied (5)

How satisfied are you with MARTA service overall?

- Very satisfied (1)
- Satisfied (2)
- Neither satisfied nor dissatisfied (3)
- Dissatisfied (4)
- Very dissatisfied (5)
Would you recommend on-demand transit service (like MARTA Reach) to a friend or relative?

- Definitely would (1)
- Probably would (2)
- Undecided (3)
- Probably would not (4)
- Definitely would not (5)

How often would you ride an on-demand transit service (like MARTA Reach) in the future?

- More often (1)
- About the same (2)
- Less often (3)
- Not at all (4)
- Not sure (5)
For each of the following performance areas, please rate MARTA Reach service using a 1 to 10 scale, with 1 being “Poor” and 10 being “Excellent”.

<table>
<thead>
<tr>
<th>Poor average</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Excellent average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drivers are courteous ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drivers easily found my pick-up location ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARTA keeps me informed of changes to my ride request ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach picks me up in the amount of time I expected ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach rides do not leave before I expect them to ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach is safe to ride ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach stops are safe to wait at ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach journey times are what I expected ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach stops are well-located ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach helps me access places I want to go more easily ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the past few months while Reach has operated, considering your trips to work / school, please indicate how often you used each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th></th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARTA Reach (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARTA Rail / Bus</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Paratransit (Mobility) (8)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other public transit (GRTA, CobbLinc, etc) (2)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mode of Travel</td>
<td>Count</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-------------------------</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With others in car, van (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxi, Uber, Lyft, etc. (5)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle, Scooter (6)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Walk (7)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
In the past few months while Reach has operated, considering your trips to locations other than work / school (social, shopping, etc), please indicate how often you used each of the
following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th>Service</th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARTA Reach (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARTA Rail / Bus (10)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Paratransit (Mobility) (8)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other public transit (GRTA, CobbLinc, etc) (2)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>Code</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alone in personal car, truck, van, or motorcycle</td>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With others in car, van</td>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxi, Uber, Lyft, etc.</td>
<td>(5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle, Scooter</td>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>(7)</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Other</td>
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<tr>
<td>(please specify):</td>
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<tr>
<td>(9)</td>
<td></td>
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</tr>
</tbody>
</table>

Page Break
How do you usually pay your fare?

- Cash on bus (1)
- Regular 30-day Breeze pass (2)
- 1-7 day Breeze pass (3)
- Half-fare Breeze (4)
- Mobility Breeze (5)
- Breeze Card with specific number of trips loaded (6)
- Year pass from employer (7)
- Regular Breeze with stored value (8)
- No response (9)
- Other (please specify): (10)
Do you have a smartphone?

○ Yes (1)

○ No (2)

○ Not sure (3)

Do you have a data plan on your phone?

○ Yes (1)

○ No (2)

○ Not sure (3)

Did you ever request a MARTA Reach ride using a phone call?

○ Yes (1)

○ No (2)

○ Not sure (3)
Did you ever request a MARTA Reach ride using a phone call? = Yes

Did the phone call meet your expectations?

○ Yes (1)

○ No (2)

○ Not sure (3)

Please tell us why the phone call did not meet your expectations.

__________________________________________________________________________________________
Display This Question:

- If Do you have a smartphone? = Yes
- And Do you have a data plan on your phone? = Yes
- Or Do you have a data plan on your phone? = Not sure
- And Do you have a smartphone? != No

Please indicate how much you agree or disagree with the following statements regarding the MARTA Reach app.
<table>
<thead>
<tr>
<th>Strongly agree (6)</th>
<th>Agree (7)</th>
<th>Neutral (8)</th>
<th>Disagree (9)</th>
<th>Strongly disagree (12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy to request a ride (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I could get information I needed about my ride (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The past rides feature was useful to me (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The app helped me understand Reach's service area (7)

Have you already taken the Registration survey?

- Yes (1)
- No (2)
- Not sure (3)

End of Block: Default Question Block

Start of Block: Registration

Please select your primary language spoken at home.

▼ English (1) ... Other (7)
How well do you speak English?

- Fluent (1)
- Advanced (2)
- Intermediate (3)
- Basic (4)
- I do not speak English (5)

What language do you speak at home?

________________________________________________________________
Which gender do you identify as?

- Man (1)
- Non-binary (2)
- Woman (3)
- Prefer to self-describe: (4)
- Prefer not to answer (5)
In which of the following categories does your age fall?

- 18 to 24 (1)
- 25 to 34 (2)
- 35 to 44 (3)
- 45 to 54 (4)
- 55 to 64 (5)
- 65 and older (6)
- Prefer not to answer (7)
Which of the following categories best represents your total annual household income before taxes?

- Under $10,000 (1)
- $10,000 to $14,999 (2)
- $15,000 to $19,999 (3)
- $20,000 to $24,999 (4)
- $25,000 to $29,999 (5)
- $30,000 to $34,999 (6)
- $35,000 to $39,999 (7)
- $40,000 to $49,999 (8)
- $50,000 to $74,999 (9)
- $75,000 to $99,999 (10)
- $100,000 to $149,999 (11)
- $150,000 to $199,999 (12)
$200,000 or more (13)

Prefer not to answer (14)
Which of the following describes you? Select all that apply.

☐ Black or African American (1)

☐ White or Caucasian (2)

☐ Hispanic or Latino (3)

☐ Asian (4)

☐ Indigenous American, Native American or Alaskan Native (5)

☐ Native Hawaiian or other Pacific Islander (6)

☐ Prefer not to answer (7)

☐ Other (please specify): (8)

__________________________________________________

__________________________________________________

__________________________________________________
What is the highest level of education you have completed?

- Less than 9th grade (1)
- From 9th grade to 12th grade (no diploma) (2)
- High school graduate (3)
- Some college but no bachelor's degree (4)
- Bachelor's degree (5)
- Graduate work and postgraduate degree (6)
- Prefer not to answer (7)

________________________________________________________________

How many persons, including yourself and any children, are in your household? Number must be at least 1.

________________________________________________________________

How many of these persons in your household are children under the age of 18?
What is your home address? We will not share this information and no one will contact you. This information will help the MARTA Reach team examine the success of the pilot.

________________________________________________________________________

Page Break

How long have you been using MARTA?

○ Long-time regular rider (1)

○ Long-time infrequent rider (2)

○ Began riding recently (3)

○ Never ridden MARTA before (4)

If you are willing to share your Breeze Card number, we will be able to look up how many trips you've taken with MARTA before, during, and after the Reach pilot. We will not share this information with anyone and we cannot access your financial information or other personal details through your Breeze Card number.
Enter 20-digit Breeze Card number in format XXXXXXXXXXXXXXXXXXXXX. You may upload a photo of the back of your Breeze Card in the next question instead of writing down the number if you would prefer. We will not share this information with anyone.

Please upload a photo of the back of your Breeze Card if you did not write down your Breeze Card number above.

Page Break

How did you hear about Reach?

- MARTA marketing materials (1)
- Word of mouth (2)
- Saw Reach vehicle and looked up the service (3)
- Saw Reach app and looked up the service (4)
- Other (please specify): (5)
Have you already taken a Trip survey?

- Yes (1)
- No (2)
- Not sure (3)

End of Block: Default Question Block 2

Start of Block: Trip
Please think back to your most recent trip on MARTA Reach. How would you have made this trip if MARTA Reach was not available? Select all that apply.

- [ ] Would not make this trip (1)
- [ ] MARTA Bus (2)
- [ ] MARTA Mobility (3)
- [ ] MARTA Rail (4)
- [ ] Drive myself (5)
- [ ] Ride with someone (6)
- [ ] Taxi / Uber / Lyft (7)
- [ ] Walk (8)
- [ ] Bike (9)
- [ ] E-Scooter / Bikeshare (10)
☐ Other (please specify): (11)

__________________________________________________

Page Break
Where were you traveling TO on this one-way trip?

○ Work (1)

○ School (2)

○ Grocery shopping (3)

○ Retail shopping (4)

○ Social trip (visiting friend; movie; dinner; etc.) (5)

○ Special event (sporting events; concert; etc.) (6)

○ Medical facility (7)

○ Airport (for travel) (8)

○ Home (9)

○ Other (please specify): (10)
Where were you traveling FROM on this one-way trip?

- Work (1)
- School (2)
- Grocery shopping (3)
- Retail shopping (4)
- Social trip (visiting friend; movie; dinner; etc.) (5)
- Special event (sporting events; concert; etc.) (6)
- Medical facility (7)
- Airport (for travel) (8)
- Home (9)
- Other (please specify): (10)
Where is ${QT2/ChoiceGroup/SelectedChoices} located?  (For large, easily identifiable locations, just write in the name - Ex: Airport, Perimeter Mall, GWCC, MB Stadium)
Street address OR nearest street and cross street:
________________________________________________________________

Where is ${QT3/ChoiceGroup/SelectedChoices} located?  (For large, easily identifiable locations, just write in the name - Ex: Airport, Perimeter Mall, GWCC, MB Stadium)
Street address OR nearest street and cross street:
________________________________________________________________
End of Block: Trip

Start of Block: Default Question Block 3

How could we have made your experience with Reach better?

End of Block: Default Question Block 3
**A.1.4 Registration backfill**

MARTA and Georgia Tech will be using your answers to evaluate the success of Reach and how well this pilot served customers like you. Please only take the survey if you are 18 years or older. We greatly appreciate you taking the time to fill out this survey.

www.itsmarta.com/reach

To request this information in an accessible format or another language, please call 404-848-4037.

Your email address is $\{e://Field/Email\}$. If this is not correct, please enter your email address below:
Considering your trips to work / school **prior to the introduction of Reach service**, please indicate how often you use each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th></th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With others in car, van (2)</td>
<td></td>
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<tr>
<td>Public transit (MARTA, CobbLinc, etc) (3)</td>
<td></td>
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</tr>
</tbody>
</table>

158
<table>
<thead>
<tr>
<th>Mode of Transportation</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxi, Uber, Lyft, etc.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>Bicycle, Scooter (5)</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>Walk (6)</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>Paratransit (Mobility)</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>
Considering your trips to non-work locations (social, shopping, etc) prior to the introduction of Reach service, please indicate how often you use each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th>Activity</th>
<th>Never (1)</th>
<th>Less than once a month (2)</th>
<th>1-3 days a month (3)</th>
<th>1-2 days a week (4)</th>
<th>3-4 days a week (5)</th>
<th>5 or more days a week (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
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<td>With others in car, van (2)</td>
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<td>Public transit (MARTA, CobbLinc, etc) (3)</td>
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</tr>
<tr>
<td>Taxi, Uber, Lyft, etc.</td>
<td>o</td>
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<td>o</td>
</tr>
<tr>
<td>Bicycle, Scooter</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
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<td>Walk</td>
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<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Paratransit (Mobility)</td>
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<td>o</td>
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<td>o</td>
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<tr>
<td>Other (please specify)</td>
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</tbody>
</table>

End of Block: Default Question Block
A. (READ STATEMENT) Hello, MARTA and Georgia Tech are conducting a joint research project to evaluate the success of Reach. Do you have a few minutes to answer some questions and are you at least 18 years of age?

1. Yes – agree and 18 or older (Go to QC)  2. No or under 18 (GO TO B AND FILL OUT REFUSAL)

B1. Type of refusal:

1. Verbal refusal (not associated with a language barrier)  2. Non-verbal refusal

3. Language barrier  4. Under 18 years of age

C. RECORD INTERVIEW START TIME _____:_______ (Military Time)

D. Email What is the email address you used to sign up for MARTA Reach?

_____________________________@__________________._________

Q1. How satisfied are you with MARTA Reach service? (READ LIST. CIRCLE ONLY ONE)
2. Satisfied 4. Dissatisfied

99. DNR

Q2. How satisfied are you with MARTA service overall? (READ LIST. CIRCLE ONLY ONE)

2. Satisfied 4. Dissatisfied

99. DNR

Q3. Would you recommend on-demand transit service (like MARTA Reach) to a friend or relative? (READ LIST. CIRCLE ONLY ONE)

1. Definitely would 3. Undecided 5. Definitely would not
2. Probably would 4. Probably would not

99. DNR

Q4. How often would you ride an on-demand transit service (like MARTA Reach) in the future?

1. More often 3. Less often 5. Not sure
2. About the same 4. Not at all
**Q5.** For each of the following performance areas, please rate MARTA Reach service using a 1 to 10 scale, with 1 being “Poor” and 10 being “Excellent” (NOTE TWO COLUMNS).

<table>
<thead>
<tr>
<th>Performance area</th>
<th>Rating (1 to 10 scale)</th>
<th>Performance area</th>
<th>Rating (1 to 10 scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drivers are courteous</td>
<td></td>
<td>Reach is safe to ride</td>
<td></td>
</tr>
<tr>
<td>Drivers easily found my pick-up location</td>
<td></td>
<td>Reach stops are safe to wait at</td>
<td></td>
</tr>
<tr>
<td>MARTA keeps me informed of changes to my ride request</td>
<td></td>
<td>Reach journey times are what I expected</td>
<td></td>
</tr>
<tr>
<td>Reach picks me up in the amount of time I expected</td>
<td></td>
<td>Reach stops are well-located</td>
<td></td>
</tr>
</tbody>
</table>
Reach rides do not leave before I expect them to | Reach helps me access places I want to go more easily

**Q6.** In the past few months while Reach has operated, considering your trips to **work** / **school**, please indicate how often you used each of the following means of transportation for such trips: (READ OUT AND MARK ONE FOR EACH MODE)

<table>
<thead>
<tr>
<th>Mode ↓ Frequency →</th>
<th>Never</th>
<th>Less than once a month</th>
<th>1-3 days a month</th>
<th>1-2 days a week</th>
<th>3-4 days a week</th>
<th>5 or more days a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARTA Reach</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARTA Rail/Bus</td>
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<tr>
<td>Paratransit</td>
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<td>(Mobility)</td>
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<tr>
<td>Other public transit</td>
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<tr>
<td>Alone in personal veh.</td>
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<tr>
<td>With other in veh.</td>
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</tbody>
</table>
Q7. In the past few months while Reach has operated, considering your trips to locations other than work / school (social, shopping, etc), please indicate how often you used each of the following means of transportation for such trips: (READ OUT AND MARK ONE FOR EACH MODE)

<table>
<thead>
<tr>
<th>Mode ↓</th>
<th>Frequency →</th>
<th>Never (less than once a month)</th>
<th>1-3 days a week</th>
<th>1-2 days a week</th>
<th>3-4 days a week</th>
<th>5 or more days a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARTA Reach</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MARTA Rail/Bus</td>
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<tr>
<td>Paratransit (Mobility)</td>
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<tr>
<td>Alone in personal veh.</td>
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<tr>
<td>With other in veh.</td>
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<td></td>
</tr>
<tr>
<td>Taxi, Uber, Lyft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle, scooter</td>
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<tr>
<td>Walk</td>
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<tr>
<td>Other (specify):</td>
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</tr>
</tbody>
</table>

**QT1.** How would you have made this trip if MARTA Reach was not available? Select all that apply.

1. Would not make this trip
2. MARTA Bus
3. MARTA Mobility
4. MARTA Rail
5. Drive myself
6. Ride with someone
7. Taxi / Uber / Lyft
8. Walk
9. Bike
10. E-scooter / bikeshare
11. Other:

**QT2.** Where are you traveling TO on this one-way trip? (READ LIST. CIRCLE ONLY ONE)
1. Work 5. Social trip (visiting friend; movie; dinner; etc.)

2. School 6. Special event (a Braves game; concert; etc.)

3. Grocery shopping 7. Airport (for travel)

4. Retail shopping 8. Home

99. DNR 98. Other (Specify): _______________________

QT2A. Where is <ANSWER IN QT2>? (Street address, cross street, or name of well-known location)

QT3. Where are you traveling FROM on this one-way trip? (READ LIST. CIRCLE ONLY ONE)

1. Work 5. Social trip (visiting friend; movie; dinner; etc.)

2. School 6. Special event (a Braves game; concert; etc.)

3. Grocery shopping 7. Airport (for travel)

4. Retail shopping 8. Home

99. DNR 98. Other (Specify): _______________________

QT3A. Where is <ANSWER IN QT3>? (Street address, cross street, or name of well-known location)

Q8. How do you usually pay your fare? (READ LIST. CIRCLE ONLY ONE)
1. Cash on bus  
2. Regular 30-day Breeze pass  
3. 1-7 day Breeze pass  
4. Half-fare Breeze pass  
5. Mobility Breeze  
6. Breeze Card with specific number of trips loaded  
7. Year pass from employer  
8. Regular Breeze with stored value  
9. DNR

Q9. Do you have a smartphone? (READ LIST. CIRCLE ONLY ONE)

1. Yes  
2. No  
3. Not sure  
99. DNR

Q10. Do you have a data plan on your phone? (READ LIST. CIRCLE ONLY ONE)

1. Yes  
2. No  
3. Not sure  
99. DNR

Q10a. Did you ever request a MARTA Reach ride using a phone call? (READ LIST. CIRCLE ONLY ONE)

1. Yes  
2. No (Skip to Qapp1)  
3. Not sure (Skip to Qapp1)
Q10b. Did the phone call meet your expectations? (READ LIST. CIRCLE ONLY ONE)

1. Yes (Skip to Qapp1)  
2. No  
3. Not sure (Skip to Qapp1)

Q10c. Please explain why the phone call did not meet your expectations.

Qapp1. Please indicate how much you agree or disagree with the following statements regarding the MARTA Reach app. (READ OUT AND MARK ONE FOR EACH STATEMENT)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Frequency</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>DNR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>It was easy to request a ride</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>I could get the information I needed about my ride</td>
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<td></td>
</tr>
</tbody>
</table>
The past rides feature was useful to me

The app helped me understand Reach’s service area

QR13. How did you hear about Reach? (READ LIST. CIRCLE ONLY ONE)

1. MARTA marketing materials
2. Word of mouth

3. Saw Reach vehicle and looked it up
4. Saw Reach app and looked it up

99. DNR

___________

QR1. What is your primary language spoken at home?

If not English, how well does the respondent speak English?

1. Fluent
2. Advanced
3. Intermediate
4. Basic
5. Doesn’t speak English

QR4. What is your gender? ________________________
**QR5.** Which of the following categories best describes your age? (READ LIST. CIRCLE ONLY ONE)

1. 18-24  
2. 25-34  
3. 35-44  
4. 45-54  
5. 55-64  
6. 65 or Over  
99. DNR

**QR6.** Which of the following categories best represents your total household income before taxes? (READ LIST. CIRCLE ONLY ONE)

1. Under $10,000  
2. $10,000 - $14,999  
3. $15,000 - $19,999  
4. $20,000 - $24,999  
5. $25,000 - $29,999  
6. $30,000 - $34,999  
7. $35,000 - $39,999  
8. $40,000 - $49,999  
9. $50,000 - $74,999  
10. $75,000 - $99,999  
11. $100,000 - $149,999  
12. $150,000 - $199,999  
13. $200,000 or more  
99. DNR

**QR7.** Which of the following describes you? You can select as many as you like.

1. Black or African American  
2. White or Caucasian  
3. Hispanic or Latino  
4. Asian  
5. Indigenous American, Native American or Alaska Native  
6. Native Hawaiian or other Pacific Islander  
7. Other:  
99. DNR

**QR8.** What is the highest level of education you have completed? (READ LIST. CIRCLE ONLY ONE)
1. Less than 9th grade  
2. From 9th grade to 12th grade  
3. High school graduate  
4. Some college but no bachelor’s degree  
5. Bachelor’s degree  
6. Graduate work or postgraduate degree  

99. DNR

QR9. How many persons, including yourself and any children, are in your household?  
__________________________

QR10. How many of these persons in your household are children under the age of 18?  
__________________________

QR11. What is your home address? We will not share this information and no one will contact you. This information will help the MARTA Reach team examine the success of the pilot.

QR12. How long have you been using MARTA? (READ LIST. CIRCLE ONLY ONE)

1. Long-time regular rider  
2. Long-time infrequent rider  
3. Began riding recently  
4. Never ridden MARTA before  
99. DNR

QRBR. If you are willing to share your Breeze Card number, we will be able to look up how many trips you’ve taken with MARTA before, during, and after the Reach pilot. We will not share this information with anyone and we cannot access your financial information or other personal details through your Breeze Card number. (Enter 20-digit Breeze Card number in format XXXXXXXXXXXXXXXXXXXXX.)
Q13. How could your MARTA Reach experience have been better?

End. RECORD INTERVIEW END TIME   ____:______ (Military Time) THANK YOU!!
A.2 Non-rider survey

We noticed you registered for MARTA Reach but did not take a ride with us. MARTA and Georgia Tech are in the process of evaluating the success of Reach to understand the impact of offering on-demand transit service to neighborhoods like yours. We really need input from people like you who showed interest in Reach but were unable to take a ride. We appreciate your participation in this short survey. Please only take the survey if you are 18 years or older. www.itsmarta.com/reach

Continue to the survey by clicking the arrow below.

To request this information in an accessible format or another language, please call 404-848-4037.

Your email address is $e://Field/RecipientEmail}. If this is not correct, please enter your email address below:
Considering your trips to work / school please indicate how often you use each of the following means of transportation for such trips (on mobile: expand menu for each mode type):
<table>
<thead>
<tr>
<th></th>
<th>Never (1)</th>
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<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>With others in car, van (2)</td>
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<td>○</td>
</tr>
<tr>
<td>Public transit (MARTA, CobbLinc, etc.) (3)</td>
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<td>○</td>
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<tr>
<td>Taxi, Uber, Lyft, etc.</td>
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<td>Bicycle, Scooter</td>
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<tr>
<td>Paratransit (Mobility)</td>
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<td>Other (please specify):</td>
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<tbody>
<tr>
<td>Alone in personal car, truck, van, or motorcycle (1)</td>
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<td>With others in car, van (2)</td>
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<td>Public transit (MARTA, CobbLinc, etc.) (3)</td>
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<td>Mode of Transportation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Taxi, Uber, Lyft, etc.</td>
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<td>Bicycle, Scooter (5)</td>
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<td>Walk (6)</td>
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<td>Paratransit Mobility (7)</td>
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<td>Other (please specify)</td>
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</table>

Page Break
How long have you been using MARTA?

- Long-time regular rider (1)
- Long-time infrequent rider (2)
- Began riding recently (3)
- Never ridden MARTA before (4)

Display This Question:

If How long have you been using MARTA? != Never ridden MARTA before

How satisfied are you with MARTA service?

- Very satisfied (1)
- Satisfied (2)
- Neither satisfied nor dissatisfied (3)
- Dissatisfied (4)
- Very dissatisfied (5)
Our records indicate that you signed up for Reach but did not take a ride. Which of the following best describes the reason you did not take a ride with Reach? Select all that apply.

- [ ] I did take a ride on Reach (1)
- [ ] I did not understand how to use the service (8)
- [ ] Reach did not go where I need to go (2)
- [ ] Reach doesn't operate late enough or early enough (3)
- [ ] I had issues with the app (could not install the app on my phone, etc.) (4)
- [ ] I had issues with the service (requested a ride but it never showed up, pickup took too long, etc.) (5)
- [ ] Other options are cheaper than Reach (6)
- [ ] Other (please specify): (7)

__________________________________________________

__________________________________________________

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184
If Our records indicate that you signed up for Reach but did not take a ride. Which of the following...
I≠ I <strong>did</strong> take a ride on Reach

If you'd like to tell us more about the reason(s) you didn't take Reach, please do so below:

________________________________________________________________

Page Break

Please select your primary language spoken at home.

▼ English (1) ... Other (7)

Display This Question:
If Please select your primary language spoken at home. I≠ English

How well do you speak English?

○ Fluent (1)

○ Advanced (2)

○ Intermediate (3)

○ Basic (4)

○ I do not speak English (5)
What language do you speak at home?

________________________________________________________________

Which gender do you identify as?

○ Man (1)

○ Non-binary (2)

○ Woman (3)

○ Prefer to self-describe: (4)

○ Prefer not to answer (5)
In which of the following categories does your age fall?

○ 18 to 24 (1)

○ 25 to 34 (2)

○ 35 to 44 (3)

○ 45 to 54 (4)

○ 55 to 64 (5)

○ 65 and older (6)

○ Prefer not to answer (7)
Which of the following categories best represents your total annual household income before taxes?

- Under $10,000 (1)
- $10,000 to $14,999 (2)
- $15,000 to $19,999 (3)
- $20,000 to $24,999 (4)
- $25,000 to $29,999 (5)
- $30,000 to $34,999 (6)
- $35,000 to $39,999 (7)
- $40,000 to $49,999 (8)
- $50,000 to $74,999 (9)
- $75,000 to $99,999 (10)
- $100,000 to $149,999 (11)
- $150,000 to $199,999 (12)
☐ $200,000 or more (13)

☐ Prefer not to answer (14)
Which of the following describes you? Select all that apply.

- ☐ Black or African American (1)
- ☐ White or Caucasian (2)
- ☐ Hispanic or Latino (3)
- ☐ Asian (4)
- ☐ Indigenous American, Native American or Alaskan Native (5)
- ☐ Native Hawaiian or other Pacific Islander (6)
- ☑ Prefer not to answer (7)
- ☐ Other (please specify): (8)

__________________________________________________
What is the highest level of education you have completed?

- Less than 9th grade (1)
- From 9th grade to 12th grade (no diploma) (2)
- High school graduate (3)
- Some college but no bachelor's degree (4)
- Bachelor's degree (5)
- Graduate work and postgraduate degree (6)
- Prefer not to answer (7)

How many persons, including yourself and any children, are in your household? Number must be at least 1.

How many of these persons in your household are children under the age of 18?
What is your home address? We will not share this information and no one will contact you. This information will help the MARTA Reach team examine the success of the pilot.

If you are willing to share your Breeze Card number, we will be able to look up how many trips you've taken with MARTA. This information allows us to compare with people who used Reach during the pilot. We will not share this information with anyone and we cannot access your financial information or other personal details through your Breeze Card number.

Enter 20-digit Breeze Card number in format XXXXXXXXXXXXXXXXXXXXXXXX. You may upload a photo of the back of your Breeze Card in the next question instead of writing down the number if you would prefer. We will not share this information with anyone.

Please upload a photo of the back of your Breeze Card if you did not write down your Breeze Card number above.
How did you hear about Reach? (Select all that apply.)

☐ Word of mouth (2)

☐ Saw Reach vehicle and looked up the service (3)

☐ Saw Reach app and looked up the service (4)

☐ MARTA marketing materials at a station (6)

☐ MARTA marketing materials on social media (7)

☐ MARTA marketing materials on the bus (8)

☐ Other (please specify): (5)

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Thank you for completing the survey. Below is space if you would like to make any additional comments about MARTA Reach.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
REFERENCES


